



***Office for Information Resources
GIS Services***

Tennessee Base Mapping Program Technical Specifications

***Prepared by
Office for Information Resources and
Comptroller of the Treasury
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1.	Revise all sections for a variety of text edits, errors, document formatting, and typographical errors.	
	Table Impacted:	<i>None</i>
2.	Revise DTM compilation description; add compilation rules for tree outline features.	
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6.	Added Appendix C: Ortho Update Pilot Specifications	
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Executive Summary

A multipurpose Geographic Information System (GIS) digital database is being developed by the State of Tennessee. Conventional aerial photography at two different scales, 1:30,000 (1"=2500') and 1:7,500 (1"=625') together with airborne GPS and GPS ground control surveys are being acquired. This data source is used to create digital orthophotography to include a digital surface model; street centerline data, hydrography and drainage data, and limited vegetation cover data. Using this ortho image as a snapshot of on-ground conditions, the manually produced and maintained parcel maps by the State are digitized using the imagery as a backdrop.

The Base Mapping Program was initiated by the Comptroller of the Treasury, Division of Property Assessments in 1996 with a two county pilot program whose goal was to define specifications for this effort and to test the concept of a digital, state-wide mapping program. This first phase of the pilot program included Maury County and Lewis County in Middle Tennessee. At the conclusion of the first phase, examination of the results indicated several key factors. First, the concept was proven to be valid and the goal achievable with current digital mapping technologies. Second, the resulting specifications were adequate for the geography of the two pilot programs. One of the two pilot counties is characterized, as predominately rural while the other county is a mix of rural and metropolitan geographies. Since this program was visioned as state-wide, and there are many communities in the State that are completely metropolitan, it was decided to continue the Pilot program with Phase Two for several areas of the State that are highly developed and predominately urban, while holding the specification fixed. It was determined that Hamilton, Montgomery and Sullivan Counties had ideal characteristics to validate the specifications developed in the first phase. Data creation for these counties was completed in December 1998.

The original specifications were the culmination of the Pilot Mapping Program. These specifications are intended to be a specific guideline for the Production Phase of the program. This represents the fourth revision since the Production Phase began in 2000. A recap of changes implemented in the previous revisions appears in Appendix B.

During the conversion of the parcel maps, linkage to the Comptroller of the Treasury Computer Assisted Appraisal System (CAAS) database is created. The basic geographic production unit is the county and associated 1"= 100' and 1"= 400' map sheets as identified on the Index Map for each county. Data conversion will take place on a county-by-county basis. There is no partial conversion for geographic areas smaller than a county.

The Task Flow Chart below is a generalized workflow for each county. This Technical Specification document is organized in a manner that reflects the logical workflow that is presented below in Figure 1. These specifications shall be adhered to for all GIS data products developed for the TNBMP.

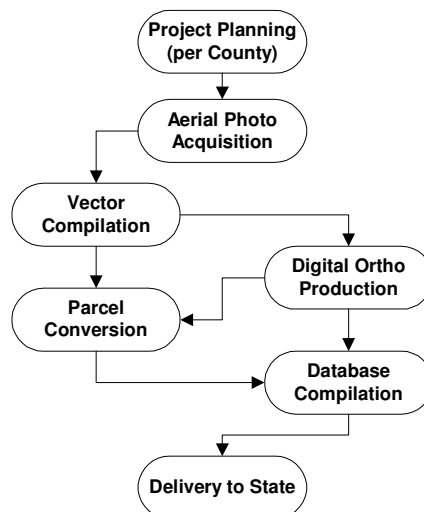


Figure 1: Task Flow Chart

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1 AERIAL PHOTOGRAPHY

General Requirements

- Leaf-off flying conditions
- Camera to have an Area Weighted Average Resolution (AWAR) of 85 minimum with forward motion compensation (FMC) and 6-inch lens focal length
- U. S. Geological Survey camera calibration certificate within past 3 years to meet or exceed National Aerial Photography Program (NAPP) standards (copy must be supplied to the State)
- Eight well defined fiducials to show on the exposed film
- Numbering and titling of film to be electronically exposed
- Scales 1:30,000 and nominally 1:7,500
- Sun angle 30 degrees or higher
- Panchromatic film
- Terrain conditions: no snow, no flooding
- Either Kodak or Agfa film may be used.
- Real time differential GPS navigation and shutter release at predefined coordinates

Aerial photography will also conform to the ASPRS Draft Aerial Photography Standard as published in Photogrammetric Engineering & Remote Sensing, Vol. LXI (9), pp. 1097-1103 dated September 1995, except for the requirements for film titling. These standards do not include reference to airborne GPS and electronic film titling, both of which are required. Inertial Measurement Unit (IMU) technology is acceptable in place of conventional Aerotriangulation.

Layout/Flight Planning

The basis for collection of aerial photography and flight mission planning will be the county Index of Property Maps. During the Project Planning Phase for each county, an up-to-date Index will be obtained either from the State or the County Assessor's Office. Prior to acquisition of photography, a flight index will be prepared and submitted to the State for approval.

All photography will be acquired with exposures positioned on the center south edge and center north edge of each map sheet. This design will provide a nominal forward overlap of 65% and sidelap of 38%. Minimum forward overlap in all cases will be 60% and minimum sidelap, 30%.

Automatic exposure control is encouraged but not required. An integrated flight management system such as ASCOT™ is strongly recommended.

On-board GPS

Airborne GPS data will be logged using an onboard dual frequency GPS receiver and an equivalent ground base station receiver during the acquisition of the 1:30,000 scale photography and 1:7,500 scale photography. Both receivers will be of Ashtech Z12 or better specification. GPS data will be collected on both receivers at one-second intervals and processed using on-the-fly integer cycle carrier phase ambiguity resolution techniques to obtain positions on each exposure station within an RMSE of 5 cm. Supporting ground-based GPS surveys will be conducted with sufficient accuracy to support producing final orthophoto and vector data to meet National Map Accuracy Standards at the intended scales (Refer to Section 2).

Photo Development and Sensitometry

The aerial film will be of 4 mils nominal thickness. It will be all of one type and manufacture. The film will be processed and inspected for proper exposure and development range and to ensure that the film is free from scratches, blemishes, light streaks, static marks, tears, crimps, and other defects. It must be clear, sharp, and evenly exposed across the format. There will be no clouds or cloud shadows, smoke, atmospheric haze, and objectionable shadows such as a prominent escarpment causing long shadows beyond it.

The film will be exposed and processed for a minimum density (D-min) of not less than 0.30 units above base fog, nor greater than 0.60. The maximum density (D-max) will not exceed 1.50 units. The point for density range is 1.0 density units for the average scene. Base plus fog will not exceed 0.20 density units. A step wedge (control strip) will be exposed on the leader prior to processing.

The density of the processed film will be measured with a transmission densitometer having a scale range of 0.0 to 3.0 and a 1-mm aperture. Readings will not be made closer than 1 inch to the frame edge nor closer than 1.5 inches from the frame corner. A characteristic curve and gamma plotted on standard Kodak curve-plotting graph paper is required.

Photo Reproduction

The following products will be produced:

1. The original film may be scanned from each scale of photography to cover the geographic area of each planned orthophoto, providing that an acceptable production process exists to meet all project requirements. Alternately, diapositives may be produced from the original film for scanning. The selected scan diapositives will be centered so that each orthophoto could be produced from a single diapositive image with no mosaicing.
2. A flight line index will be produced showing actual photo centers using the airborne GPS photo-center listing. The index will be overlaid to a raster rendition of the Tennessee State map at 1:250,000 or the 1:100,000 scale metric map series and will be supplied in Arc/Info coverage as described in the database design section (Refer to Section 6).
3. One set of analytical diapositives (aerotriangulation diapositives) may be printed for all exposures (at both scales) if circumstances require manual aerotriangulation to be performed. These diapositives will be used for aerotriangulation and will be cross-pugged to the scan diaps produced for orthophotography. Alternatively, the orientation parameters may be loaded into the ortho production system. The original film and analytical diapositives or scan analytical diapositives will be delivered to the State for archiving within twelve months of completion of each county.

2 PHOTOCONTROL AND GPS GROUND SURVEY SUPPORT

Methodology

The ground-survey photo control layout will be designed to support the airborne GPS (ABGPS) plan. Pre-paneled ground control points (GCP's) will be in the configuration of a "T" or a cross. For the 400-scale photography the targets will have legs a minimum of 20 feet long and 18 inches wide. For the 100-scale photography the targets will be a minimum of 7 feet long and 15 inches wide. The panels will be removed promptly after aerial photo acquisition. Photo-identifiable GCP's are acceptable in lieu of panels if necessary.

Geodetic Datum, Coordinate Systems, and Units of Measure

The survey should be performed as follows:

National Geodetic Survey Second-order horizontal and Third-order vertical

North American Datum (NAD) 83(90 Epoch) for horizontal and North American Vertical Datum (NAVD) 88 for vertical

Tennessee State Plane (Fipszone 4100) coordinate system

Unit of measure, U.S. Survey Foot

GPS surveys will be tied to Tennessee High Accuracy Reference Network (HARN)

Airborne and Ground GPS Control

A report describing the layout of the GCP's and results of the airborne and ground GPS surveys will be submitted. A generic ASCII file of control data will also be submitted. A check to validate the ground GPS against existing control that was used as part of the ground GPS network will be conducted. The control must be sufficient to insure the maps and orthophotos meet accuracy specifications.

The final report will include the following:

- Description of the survey procedures, adjustment procedures, weighting, geoid model, and reference control
- Point Descriptions and coordinates
- NGS control data recovery sheets
- Digital files:
 - Input data to adjustment
 - Error Log
 - GPS weight covariance
- Adjustment results including
 - Listing of Input Data File
 - Summary of Files Used and Option Settings
 - Summary of Unadjusted Input Observations
 - Adjusted Coordinates
 - Coordinate Changes from Entered Provisional Values
 - Adjusted Positions and Ellipsoid Heights
 - Statistical Summary
 - Adjusted Observations and Residuals
 - GPS Residual Summary
 - Adjusted Azimuths and Horizontal Distances
 - Convergence Angles and Grid Factors at Stations
 - Error Propagation
 - Final Coordinate listing of all stations in Latitude Longitude & TN State Plane
- NGS Control Data Recovery Sheets

Photo Control/GPS Aerotriangulation

For the photo control process, either an integrated on-board GPS/Inertial Measuring Unit (IMU) process or conventional aerotriangulation is acceptable as long as project accuracy specifications are met. The following processes will be followed as appropriate depending upon the photo control process implemented.

GPS/IMU:

Exterior orientation parameters will be computed through the integration of airborne GPS data and data from an IMU. The solutions will result from Kalman filter approach combining the carrier phase derived photo centers and IMU measurements of acceleration and angular rates to compute the exterior orientation parameters (X , Y , Z , ω , ϕ , and κ) of each exposure station. These values will allow the creation of stereo pairs without the need to perform Aerotriangulation. A final report will be provided that details and quantifies the integration of the GPS data and the IMU data.

CONVENTIONAL AEROTRIANGULATION:

Aerotriangulation will be performed in a hard copy environment using first-order analytical stereoplotters and precision point transfer (pugging) devices. The final aerotriangulation adjustment of the photography block will be completed using the airborne GPS photo center coordinates and further supported by photo-identifiable or pre-paneled ground control points acquired using GPS surveying or conventional surveying if necessary. Self-calibration simultaneous bundle block adjustment will be used. Softcopy aerotriangulation techniques may be considered as an alternative to the above as long as project accuracy specifications are maintained.

The final root-mean-square-error (RMSE) for the aerotriangulation adjustment will be 1:10,000 or better of the flying height for both scales of photography involved. A final aerotriangulation report outlining the approach and final results is required. A text file with all results suitable for loading into other photogrammetric mapping systems is also required.

3 PHOTOGRAMMETRIC DATA CAPTURE

Digital Terrain Models

Digital Terrain Models (DTM) will be generated using an analytical stereoplotter or softcopy workstation for compilation. Note that 3D Planimetric Data collected for these specifications (discussed in detail in the following sections) are features that will be included in the DTM collected.

DTM generation will be carried out on the 1:30,000 scale photography (where the smaller scale orthophoto generation is planned) and on the 1:7,500-nominal scale photography (where the larger scale orthophoto coverage is planned). In addition, the 3D data points captured in the hydrography and transportation vector data coverage will be added to the data sets to further strengthen the vertical accuracy of the DTM. The 2D data points captured in the tree-covered areas vector data coverage will not be added to the DTM.

The DTM data sets are intended for the production of the digital orthophoto data set.

Elevation data points (mass points) will be obtained to describe all tops, bottoms, and areas where the break lines are more than one inch apart at map scale, in such a manner that the resultant DTM correctly represents the shape of the terrain. Manual compilation methods will be used for data capture of all breaklines. Auto compilation methods for capture of mass point data are acceptable. Spot elevations in open water should be deleted.

DTMs will be compiled over-edge, out to at least 1 inch at map scale beyond the neat boundary of the map sheet so that edge effects will be eliminated. No clipping is allowed at sheet edges.

All DTM data will be supplied as points and break lines so that the least generalized data can be archived for future use. Break lines will be appropriately identified as to the planimetric feature that they correspond to. In order to avoid unnatural visual appearance of bridge decks in the ortho images produced from these DTMs, street centerlines and edge of pavements will be included as break lines with the elevation value associated with the bridge deck included in the DTM.

Planimetric Feature Definitions

All hydrographic and transportation vector data will be collected in 3D and be topologically clean. All tree-covered areas will be collected in 2D and be topologically clean. All vector data will be delivered in English units (US Survey Feet) and supplied in the Tennessee State Plane Coordinate System in NAD83 (90).

The sheet neat lines will be based on the current property maps that are in Tennessee State Plane NAD27. Because the transformation from NAD27 to NAD83 is not consistent across the state, an origin point of North 549,378 feet, and East 1,954,503 in NAD83 (90) was selected as the corner of four sheets. The corners of all other sheets can be computed from this origin point by adding or subtracting the number of sheets times the sheet size in feet. A sample computation is shown in Table 1. In the worst case, this will cause the neat lines to move by about 30 feet (maximum movement is in East Tennessee).

Easting (feet)	Northing (feet)	
1,654,700	460,000	Any point in the sheet
1,954,503	549,378	Origin point
-299,803	-89,378	Difference in coordinates
-85.658	-44.689	Divide by the sheet size to get number of sheets from the origin
-85	-44	Truncate to integer = Number of full sheets from the origin.
-297 500	-88 000	Multiply by number of feet per sheet (3500 x 2000).
1 657 003	461 378	Add to origin to get coordinate of SE sheet corner.

Table 1. Sheet Position Calculations

All final vector data will be supplied on appropriate digital media in map sheet order, for each county. The planimetric data will be delivered by 1" = 400' scale sheet. If two adjacent counties are being mapped concurrently, the sheets for one county will not be submitted for both. They will each have separate sheet numbers appropriate for each county.

HYDROGRAPHY

Feature	1:30,000 Photography	1:7,500 Photography
Standing Bodies of Water	✓	✓
Rivers	✓	✓
Streams	✓	✓
Closing Line	✓	✓

1. All waterways will be mapped as streams and show a continuous network.
2. All clearly defined channels will be mapped even though they have no water showing. Err on the side of too much mapping of streams, not too little.
3. Standing bodies of water will be mapped as closed polygons.
4. Rivers or double line streams will be mapped as closed polygons.
5. Waterways over 25 feet wide will be mapped as double-lines (closed polygons) while those less than 25 feet wide will be mapped as single-line features at both scales.
6. Artificial closing lines will be collected and included wherever a double-line stream or river and a lake or pond join.
7. All standing bodies of water will be collected as closed polygons with no type distinction required.
8. The watercourses in the stereo model will be captured as best determined from the lowest point in the model to the highest point.
9. For any hydro feature that is obscured by a bridge or other man-made feature, a hidden feature will be captured in a manner that ensures connectivity of the down-stream to up-stream drainage and completes the requirement for polygon closure for bodies of water.

TRANSPORTATION

Feature	1:30,000 Photography	1:7,500 Photography
Road Centerlines	✓	✓
Driveway Centerlines (200 ft minimum length)	✓	✓
Edge of Pavement		✓

1. All graded roads, gravel-surfaced or otherwise improved will be collected.
2. Edge of pavements and road centerlines will not be classified. Public vs. private will not be distinguished. Paved vs. unpaved will not be distinguished.
3. Unimproved roads (logging roads, jeep trails) will not be collected. Parking lots and golf course cart paths are not to be mapped.
4. Bridges will not be mapped – centerlines and edge of pavements will run straight across bridges, over and under passes, and streams.
5. Hidden road lines will be collected for any transportation feature that is obscured by a bridge or other man-made feature.
6. Driveways over two hundred feet long will be mapped. Only the centerline of driveways will be shown. A driveway is an improved vehicular traveled way that leads from a road to one or more structures.
7. Do not use fillets at intersections. The edge of pavement (EOP) at these intersections will be collected.
8. Road centerlines and driveway centerlines will be uniquely identified.
9. Centerlines and edge of pavements will not be attributed with names.
10. The actual edge of pavement (EOP) will be mapped and will only be collected for the 1:7,500 photography. Copy parallel from one side to the other is unacceptable. The EOP is compiled as a continuous feature. When a road crosses a model boundary the line strings will be mathematically snapped in 3D. For the centerlines of the roads at both scales each segment of centerline from one intersection to the next will be a separate element. The joins from one centerline element to the next will be a 3D mathematical snap.
11. Road Centerline, Driveway Centerline and EOP Improved Roads shall be differentiated when occurring on Bridge Deck. Each feature occurring on a bridge deck will be split at the edge of the bridge deck identified visible pavement surface changes or the point at which the abutment (wall) starts. The split point from one type feature to the corresponding on-deck feature will be a 3D mathematical snap.

TREE-COVERED AREAS

Feature	1:30,000 Photography	1:7,500 Photography
Tree-covered areas	✓	

1. Tree-covered areas will be collected in 2D and **not** included in the DTM.
2. All contiguous tree covered areas greater than 10 acres in size shall be collected as topologically correct polygon features.
3. The apparent area covered by tree canopy shall be collected.
4. Tree outlines shall be collected from the 1"-400' source photography only.

4 ORTHOPHOTOGRAPHY

Scanning of Film for Orthophotography.

Scanned images for orthophoto generation will be produced in TIFF 8-bit grayscale format at the following ground resolution:

- 1:30,000 scale photography - 2 ft. x 2 ft. ground pixel resolution
- 1:7,500 nominal scale photography - 0.5 ft. x 0.5 ft. ground pixel resolution

Scanning will be done with a calibrated, photogrammetric quality scanner. The geometric accuracy of the scanner after calibration will be less than or equal to 1.5 microns RMS per axis. Film will be scanned, not paper prints. The scanned image must be adequate to allow the final generated orthophoto to meet or exceed National Map Accuracy Standards for the intended scale of the orthophoto. Scan resolution will be finer than that of the final image delivered as an orthophoto. Spot checks will be made to assure that the orthophotos meet NMAS.

The scanned images will be in black-and-white. The radiometric quality of the scanned images is critical to subsequent processes. There will be no bad scan lines, visible scratches, dust, lint, dirt, smudges, or other cosmetic blemishes. Automatic scratch removal software may be used. The scanned images will be compared with the source photograph to verify that the gray scale is acceptable. Dark tones and highlights will be examined to assure that the full range of gray shades in the original negative is preserved.

Archiving of the raw scan data is not required.

Digital Orthophotos

Using the aerotriangulation solution or the integrated GPS/IMU data, the DTM data, and the scanned image files, digital orthophotos will be produced as follows:

The 1:30,000-scale photography will be used to produce digital orthophoto sheets that are 14,000' (East-West) by 8,000' (North-South). Each orthophoto will have a ground pixel resolution of 2.0' x 2.0'.

The 1:7,500-scale photography will be used to produce digital orthophotos sheets that are 3,500' (East-West) by 2,000' (North-South). Each final orthophoto will have a ground pixel resolution of 0.5' x 0.5'.

The digital orthophotos will have a horizontal accuracy of ± 2 pixels RMSE (4 feet @ 1"=400', 1 foot @ 1"=100') on all check points taken on clearly defined image detail. The mismatch between two adjoining orthophoto sheet edges will not exceed five (5) pixels.

The final digital orthophoto will cover the entire neat area of each sheet with no over-edge, even though the DTM will have been compiled over-edge.

The neatline will be orthogonal and the extent will be an even number of pixels. Neat lines are inherent in the vector data and are superimposed on the ortho image.

The cut-line between orthophotos made from 1:30,000 scale photography may be straight coinciding with the sheet neat line. The orthophotos made from the 1:7500 scale photography should be mosaiced to minimize the undesirable effect of building lean.

All orthophotos will be delivered on appropriate digital media. The files are to be written and delivered in map sheet order. Image format shall be striped GeoTIFF. The image must be uncompressed and have horizontal scan lines with a top left origin.

In addition to the required GeoTIFF format identified above, all orthophotos for a county will be compressed using multiresolution seamless image database (MrSID) format. The 1:30,000-scale photography will be delivered as a county-wide mosaic, while the 1:7,500-scale photography will be delivered as individual map sheets, unless otherwise specified by the State. Imagery at both scales shall be processed using a target compression of 20:1, with an actual compression ratio of no less than 14:1. The final products will be delivered to the State on appropriate digital media in MrSID format.

Each orthophoto will be accompanied by appropriate quality control reports: image accuracy report and digital orthophoto evaluations report form, together with written explanation criteria pertaining to the evaluation report.

Even if all sixteen 100-scale orthophotos are produced for a 400-scale map sheet, the 400-scale orthophoto will also be required.

Hard Copy Orthophotos

Upon acceptance of each digital orthophoto, hard copy plots will be generated. These plots will match the parcel sheets and formats and dimensions of the existing parcel maps. Each hard copy orthophoto sheet will have the following data embedded around or into the image.

- Marginalia and format data (to be provided by the State).
- Tennessee State Plane 5-inch grid interval.
- The neatline (edge of image) will be orthogonal, and the extent will be 7000 by 4000 picture elements (pixels).

Final black-and-white Mylar matte reproducible sheets will be plotted at either 1"=400' or 1"=100' dependent on the scale being produced with a resolution of 600 dpi or higher.

File Naming Convention

The file naming convention for digital ortho files is as follows:

1. 1" = 400' scale digital orthophoto sheets will be named with five characters, the first two representing the county code and the next three being the 400-scale sheet number.

EXAMPLE: The ortho image file for Map Sheet 34 in Maury County would be named 60034.TIF.

2. 1" = 100' scale digital orthophoto sheets will be named with six characters, the first two representing the county code, the next three the 1" = 400' scale sheet, and the alpha character identifying the 1" = 100' scale sheet.

EXAMPLE: The ortho image file for Map Sheet 112A in Montgomery County would be named 63112A.TIF.

3. 1"=400' scale digital MrSID mosaic will be named with six characters, the first two representing the county code, an underscore character, and "400", denoting the 1"=400' scale mosaic.

EXAMPLE: The MrSID in Maury County would be named 34_400.SID & 34_400.SDW (MrSID world file).

4. 1"=100' scale digital MrSID orthophoto sheets will be named with six characters, the first two representing the county code, the next three the 1"=100 scale sheet, and the alpha character identifying the 1"=100' scale sheet.

EXAMPLE: The MrSID ortho image file for Map Sheet 42C in Montgomery County would be named 63042C.SID & 63042C.SDW (MrSID world file).

A listing of county codes is included in Appendix A.

5 CADASTRAL MAPPING

Methodology

The approach for parcel conversion described in these specifications is the best-fit method. While the data dictionary shows Coordinate Geometry (COGO) specifications, these fields, and discussion of their use, are intended to assist in on-going post conversion maintenance.

The following guidelines will be used for the best-fit approach:

The parcel map is the primary source for the geometry of all parcels.

The planimetric files and the orthophoto are the primary sources for location for all parcels.

The parcel maps will be the source for location of parcels when planimetric or ortho detail does not exist.

The parcel maps contain geographic relationships between features, which must be utilized in the conversion process, such as parcel line distances to logging roads or trails or valleys.

Building lean should be accounted for in the mapping process.

All line work will be edge-matched on a file-to-file basis. All files must be 100% edge-matched.

The file-working unit will be the 400-ft scale map sheet (Refer to Section 6, Map Librarian). Separate 50-ft and 100-ft scale map sheet data will be merged into 400-ft scale files.

Plots of every parcel map (400', 100', and 50') will be created for purposes of quality review except in instances where the limited series of 50' maps are being eliminated and incorporated into the parent 100' map sheet (see County Index, Map Scale 1:600 for details).

Planimetric features such as pavement centerlines and pavement edges are displayed along with any other features that might exist. These planimetric features provide the framework for the placement of parcel lines. In addition, the digital orthophotos are used as reference information for the correct placement of parcel lines insuring a fit to obvious occupation lines.

These are the basic steps in the parcel conversion process:

Data Conversion (digitizing and best fit)

Edit (annotation and cartographic enhancements)

Primary Quality review

Digital corrections

Format and delivery (interim and final deliveries)

Final Quality review

Source Documents

The source documents for parcel conversion are the existing parcel maps, digital ortho image, planimetric and DTM data files. The parcel map Index is available as a secondary source document. A limited extraction from the county assessment database will be used as a validation and verification source for the GISLINK attribute.

All source documents will be provided by the State. The assessment database extraction will be provided by the State. All source documents must be returned in the same condition as received.

Every digital parcel map that corresponds to the active 400' and 100' index will be plotted and provided to the State of Tennessee for quality review along with an inventory listing of each map sheet included. Accompanying these check plots will be the corresponding preliminary digital parcel database as defined in these specifications. The DPA and/or county assessment personnel will review these checkplots for content errors and will provide appropriate feedback for correction. The State reserves the right to reject a checkplot submission in its entirety if there is significant errors or if the inventory list does not match the maps provided. The State may also request a set or series of verification plots to ensure corrections have been applied.

County Index

The Division of Property Assessments (DPA) developed a countywide index for each county in the state during the cadastral mapping program in the 1960s. The county index is that portion of the Stateplane grid that overlaps the total area of the county. The county index indicates standardized map scales for 1:4800, 1:1200, and 1:600 for the majority of Tennessee counties. This allows for a seamless map to be developed across county boundaries and is essential in the development of a standardized system of a statewide parcel based GIS database. In the event that a particular county has a parcel mapping system that was not originally developed to the statewide standards then a repining process must be implemented to meet the statewide standards and these digital parcel specifications.

Map Scale 1:4800

Map scale 1:4800 or 1" = 400' is the smallest of the map scales. These maps correlate to the individual grid cells in the county index and have dimensions of 14,000 x 8,000 feet. The numbering system usually starts in the upper left portion of the county with map one and continues sequentially from top to bottom until all grid cells that fall within the county are numbered (Figure 2). The total number of 1" = 400' maps depends on the size of a county and usually range between 100 and 200 map sheets. The 400' map sheets are the foundation of the mapping program and are the essential unit for developing and maintaining digital map data.

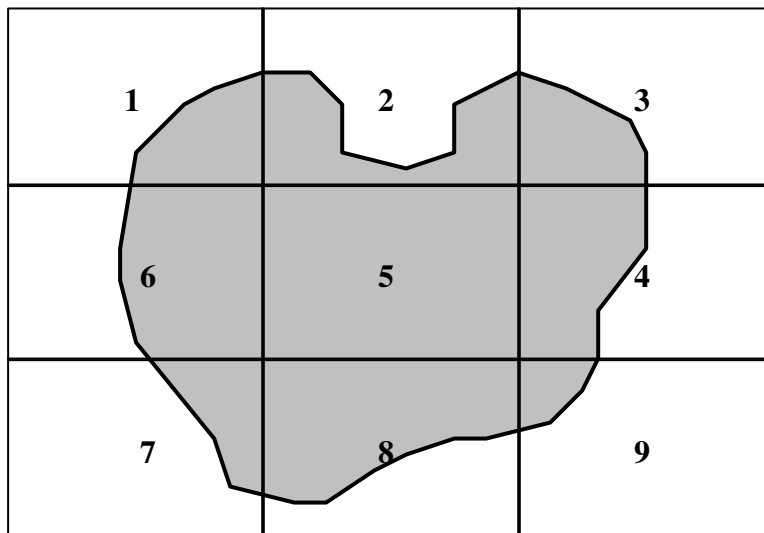


Figure 2. 1:4800 Map Sheet Numbering Scheme

Map Scale 1:1200

These map sheets represent a subset of the 400' map sheets that have dimensions of 3,500 feet x 2,000 feet. There can be up to sixteen 100' map sheets within each 400' map sheet. The numbering scheme of the 100' map sheet (Figure 3) begins with "A" in the upper left corner and ends with "P" in the lower left corner. The 100' map sheet is labeled in a serpentine pattern. The 100' maps typically cover areas of residential development in an urbanized area. Accordingly, not all 100' sheets within a 400' map sheet are present. There will be some rural 400' map sheets that may not have any 100' insets. The total number of 100' map sheets varies significantly between counties depending on urbanized characteristics of the county. New 100' map sheets will be periodically created to account for the urban growth. Parcels contained in the 100' map sheets will be digitally included within the 400' map sheet file. 100' sheets will continue to be used for cartographic purposes as well as parcel identification number (PIN) assignment.

A	B	C	D
H	G	F	E
I	J	K	L
P	O	N	M

Figure 3. 1:1200 Map Sheet Numbering Scheme

Map Scale 1:600

This map scale is utilized in highly urbanized areas such as the Town Square or central business district. There can be up to four 50' maps within a 100' map sheet. The numbering scheme of the 50' map sheet (Figure 4) begins with "A" in the upper left corner and ends with "D" in the lower left corner. The 50' map sheet is labeled in a clockwise direction. These 50' map sheets have dimensions of 1,750 x 1,000 feet but are not frequently used or developed. Some counties may not have any 50' map sheets. Similar to the 100' map sheets, they are dependent on the level of urbanization within a particular county. Condominium complexes are another example of where the use of 50' map sheets is necessary. These 50' map sheets are also included with the 400' map sheet file. 50' sheets will continue to be used for cartographic purposes as well as parcel identification number (PIN) assignment.

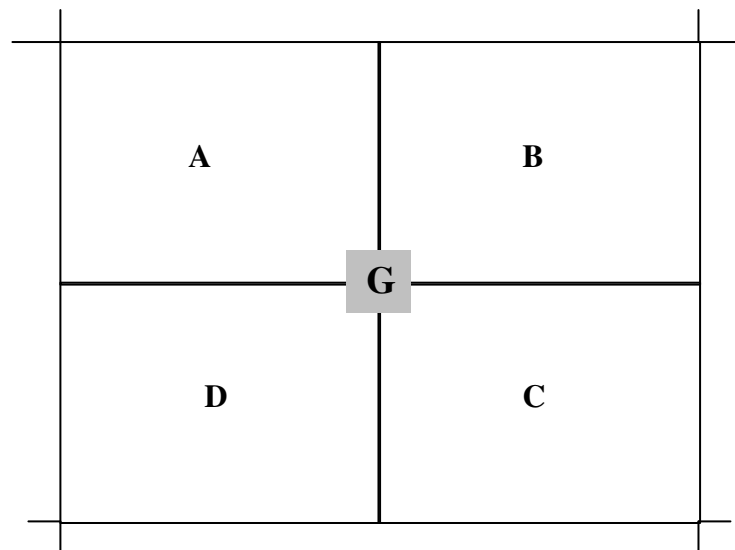


Figure 4. 1:600 Map Sheet Numbering Scheme

During the course of data conversion from manually produced and maintained parcel data to digital parcel database, the State provides each county with the option of eliminating the existing limited 50' scale map sheets. Data contained on these map sheets is retained, but incorporated into the parent 100' map sheet. This process will involve repining all existing parcels contained on these 50' map sheets as discussed in the following section. The State will notify the conversion vendor prior to the commencement of parcel conversion on the appropriate course of action to take with regards to any 50' map sheets that may exist for that county.

Repining

The repining process involves shifting the X and/or Y coordinates of the county index to match the Stateplane grid that overlaps the total area of the county. Sometimes this X and Y shifting results in the remapping of parcels at 1" = 200' to 1" = 100' which in turn requires that the county index and the extent of each individual map sheet be adjusted.

Tennessee's cadastral mapping standards require a map based parcel identification number (PIN) for each individual parcel as described in detail in the Cadastral Feature Definitions section. The adjustment of the county index move individual parcels from one map sheet to another map sheet resulting in a change to the PIN for that individual parcel.

The repining process is dependent upon capturing the old PIN from the original source documents and creating a new PIN based on the adjusted county index. For counties requiring repining, the new PIN is created in the GISLINK attribute and the old PIN is retained in the GISLINK2 attribute. (Refer to Section 6, Parcel layer description).

Repining may also occur in counties that choose to eliminate their 1" = 50' maps. These parcels are remapped to 1" = 100' and the corresponding PINs are changed accordingly. The same procedure of populating the GISLINK and GISLINK2 attributes is applied to these parcels as describe in the preceding paragraph.

Once the State receives the final digital data, the Division of Property Assessments executes a procedure to update the CAAS (real and personal property) records based on the GISLINK and GISLINK2 attributes.

Cadastral Feature Definitions

The following definitions, descriptions and discussions represent the features that are captured as part of the PARCEL data layer. Each discussion is primarily intended to be a description of how the feature appears on the typical manually produced parcel maps. Also included is information that is intended to help clarify how the feature is represented in the Database Design Section (Refer to Section 6).

Planimetric features included on the source documents are fence lines, tree outlines, ridge lines, drainage, pavement edges, field lines, etc. None of these features are captured from the source parcel maps except as noted in the "Database Design, Inclusion of Planimetric Features" Section 6. Specifically in instances where the digital compiled hydrography is captured during extremely high or low water levels, line work will be captured from the parcel map sources.

Figures 6-10, which appear at the end of this section, represent reproductions of 100' and 400' parcel maps with an example of each of these features appropriately identified. Included with each feature description is a reference to the specific figure that the item appears on. Note that in some instances such as the GISLINK, the feature does not exist on manually produced parcel maps and does not appear in any of the figures. Every item below, except for assessment line, will have one or more references in the Database Design Section 6.

ACREAGE (FIGURE 2 AND FIGURE 7)

Five types of acreage are indicated on the source map. They are deeded, calculated, survey, easement and levee. Deed and calculated acreage appear on most maps while the others are shown less frequently. Statewide, the acreage will vary in the way they are shown on some source maps. The chart below identifies type of acreage and how they may appear on the source map. Acreage should be captured and shown on the digital map as illustrated in the digital map column to improve standardization.

<u>Type of Acreage</u>	<u>Source Map</u>	<u>Digital Map</u>
Deed Acreage	AC, AC _d or ACD	AC
Calculated Acreage	AC _c or ACC	ACc
Survey Acreage	AC _s or ACS	ACs
Easement Acreage	ACcE, ACE or AC _e	ACe
Levee Acreage	AC(L) or ACLevee	ACLevee

For all scale map sheets the acreage is shown parallel to the top and bottom map neatline. The acreage will be placed directly under the parcel number and centered for 400' scale map sheets. Acreage on 100' scale map sheets is centered and placed directly under the lot number-letter (parcel numbers on 100' maps appear in the upper right hand corner). On 400' scale map sheets, acreage for parcels under one acre are not shown.

ASSESSMENT LINE (FIGURE 5)

An assessment line is a parcel boundary that identifies a portion of a parcel that extends beyond a county line into an adjacent county. A landhook is usually placed across the county line to indicate that a portion of a parcel is in an adjacent county but the entire parcel is assessed in the county being mapped. There is no unique symbology for an assessment line. These lines are shown as a parcel line but are usually distinguished with annotation indicating the extent of the county assessment. As a result, assessment lines are not included in the database design specifications.

CITY LIMIT LINE (FIGURE 4)

The city limit line identifies the extent of incorporated areas and will not form a parcel boundary. If a city limit line is coincident with any other line then both lines are captured. All city limit lines should form complete polygons. The city limit lines should be captured only from the 400' scale maps. City limit lines depicted on 100' scale maps are incomplete polygons and should be discarded.

CITY NAME (FIGURE 5)

The city name identifies the incorporated jurisdiction and appears on the inside of the city limit line. It is placed parallel to the city line at least once per map without overstriking any other text. The 400' scale map sheets are the primary source for this information.

CIVIL DISTRICT LINE (FIGURE 5)

Counties are divided into civil districts and are used for deed descriptions and historical purposes. Civil district lines will not form a parcel boundary. If a civil district line coincides with other features then each is captured. Gaps in civil district lines may occur because routine maintenance was suspended several years ago. The 400' scale map sheets are the primary source for civil district lines.

CIVIL DISTRICT NAME (FIGURE 5)

The civil district name appears on the inside of the civil district line. It is placed parallel with the district line at least once per map without overstriking any other text. The 400' scale map sheets are the primary source for civil district lines.

COMMON AREA

Common areas represent land defined as part of a condominium complex usually having joint ownership among all residents. (Refer to notes section in Parcel coverage specifications).

CONDOMINIUM FOOTPRINT (FIGURE 7)

Condominium footprints are line features that outline the shape of the condominium building. These are depicted as either parcels or special interest areas on the source maps. The footprint is shown as a parcel line if there is a parcel number in the footprint. If it has a special interest number then a solid, black, thin line represents the footprint.

CONTROL MAP NUMBER (FIGURE 5 AND FIGURE 7)

On 400' scale maps control numbers are used to identify portions of parcels that are controlled on another map. Control numbers for 400' scale maps consist of a parcel number followed by a dash and the controlling map number in a circle and underlined. On 100' and 50' scale maps, control numbers are used to identify groups of parcels that are controlled on another map. Control numbers for 100' and 50' maps consist of a group letter bound by quotations followed by a dash and the controlling map number and underlined. Underline is included in the text font size. They should be placed parallel to the top and bottom map neatline.

COUNTY LINE (FIGURE 5)

The county line is an administrative boundary that defines the total area of a county. The county line forms a parcel boundary except when the parcel is split by the county line (Refer to Assessment Line). In these situations assessment lines are used to identify a portion of the parcel in the adjacent county. Only the county line is captured if a parcel coincides with the county line and if a road or railroad line coincides with the county line. Only the state line is captured when a county line is coincident with a state line.

COUNTY NAME (FIGURE 5)

The county name is to appear on the inside of the county line. It is placed parallel to the county line at least once per map without overstriking any other text. Adjoining county names appear on the outside of the county line.

CREEK NAMES (FIGURE 5)

Creek names are to be placed in *italics* at an angle with the creek featured.

EASEMENT LINE (FIGURE 5)

Easement line identifies an area of ingress and egress through a parcel of land. Easement lines do not form parcel boundaries. Easement lines should be captured as shown on the source parcel map.

EASEMENT TEXT (FIGURE 5)

Easement text identifies the easement area and width. Text can be placed inside or outside of the easement and parallel with the easement lines.

ERRATA TEXT

This text does not appear on the source documents but is generated during data conversion.

Errata text is used to identify specific problems related to data conversion that requires investigation and resolution by the State and/or local government staff. Examples of these problems include but are not limited to; two parcel numbers for one parcel, missing dimensions, incorrect edge matching, incorrect map control number or any other conflict of this nature. Errata text should be short, descriptive and clearly identify the problem.

EXEMPT SYMBOLS (FIGURE 5)

Exempt symbols are used to identify churches, cemeteries and schools. Church and school symbols are placed parallel to the top and bottom map neat lines while cemetery symbols are placed as shown on the source parcel map. Where the exempt text appears as "Church School" a school symbol is placed.

EXEMPT TEXT (FIGURE 5)

Exempt text identifies the names of cemeteries, schools and churches. All exempt text should be placed as shown on the source parcel map and parallel with the top and bottom map neat lines.

FORMERLY ON TEXT

As part of the conversion process, some parcels may be being shifted off the map from which they were originally located. An effort is made to match the specification for text placement of the parcel number but the map it is originally on takes precedence over this. In the case where the parcel number must be placed on a different map, the following text is placed on the map where this new parcel number is located:

F/O<map-number>

The text is placed using the miscellaneous text specifications.

GAS PIPELINE (FIGURE 5)

Gas pipeline is the approximate location of a gas line. It is captured as shown on the source parcel map and is shown with special line symbology.

GAS PIPELINE TEXT (FIGURE 5)

Gas pipeline text identifies pipeline ownership. Text should be placed above or below and parallel with pipeline. The parcel map is the primary source for this information.

GISLINK

Every parcel should have a GISLINK or PIN (parcel identification number) assigned to the polygon label. The GISLINK is used as the unique identifier and serves as the link to the assessment database. The GISLINK item is found in the parcel coverage. The GISLINK value is composed of very specific combinations of the county code, control map number, 100' and 50' control map letter, group letter, parcel number and split number.

If a GISLINK value cannot be determined for a parcel, a value of 998 (unknown) is assigned to the Code item and the GISLINK field is assigned a unique value to distinguish it from other unknown regions. The unique value will be composed of the county number, control map number, 100' and/or 50' control map number (if appropriate), the text string "UNK", and a 2 digit sequential number starting with 01 for each map sheet. For example, the first unknown GISLINK value for the first parcel on map 133 in county 006 would be 006133____UNK01, the second unknown GISLINK for the same map would be 006133____UNK02, etc. (Note: there are 4 blank spaces between 133 and "UNK".)

The assignment of the GISLINK value for 400', 100', and 50' maps is illustrated in the following three graphics. The underscore(s) (_) in each of the graphics below represents a blank space in the actual GISLINK field value. Do not insert an underscore in the GISLINK field; blank spaces are valid and necessary.

400' Example--parcel 1.01 on map 133 translates to the GISLINK value:

060133 00101

060 County number

133 Control map number

100' Control map insert letter

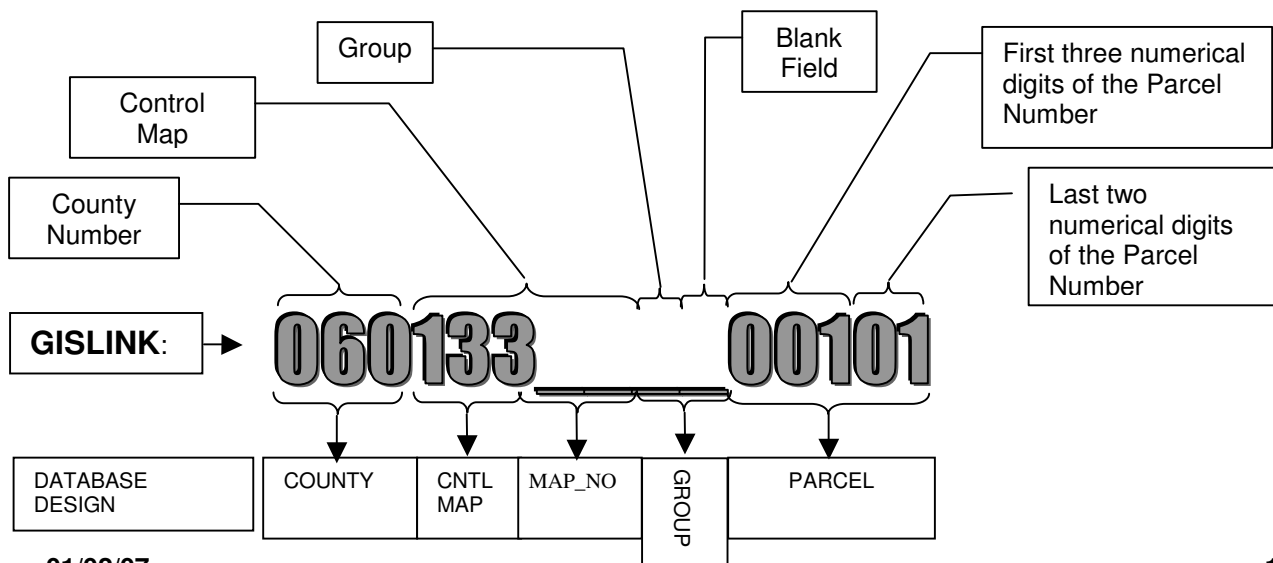
50' Control map insert letter

Group letter

Blank space

001 Parcel number

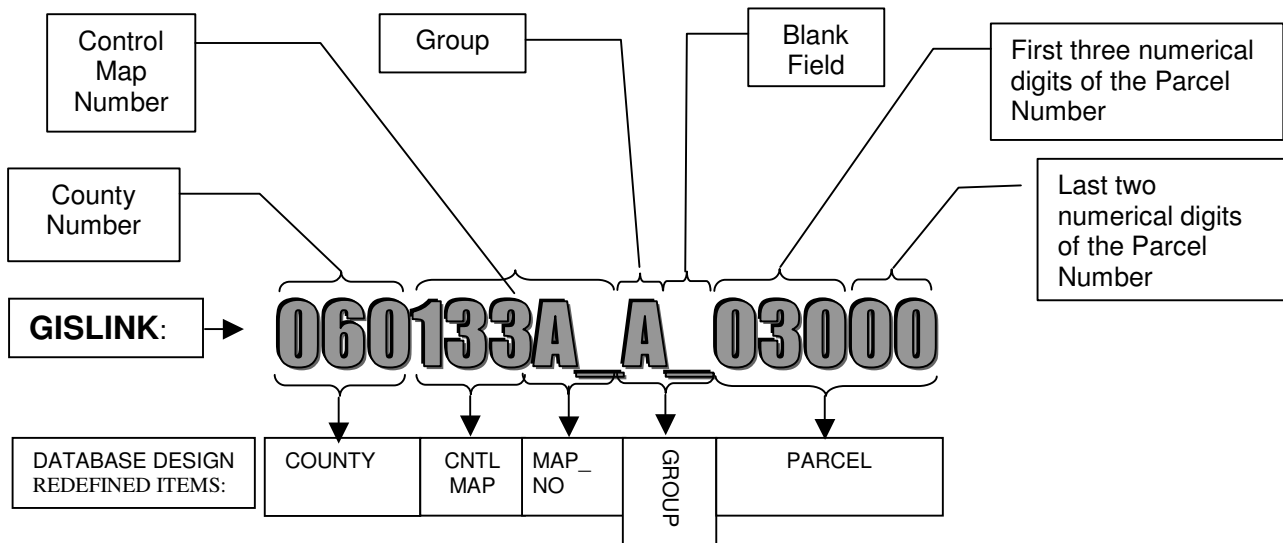
01 Split number (If the parcel does not have a split number, two zeros should be placed instead).



100' Example--parcel 30 in group A, on map 133A translates to the GISLINK value:

060133A A 03000

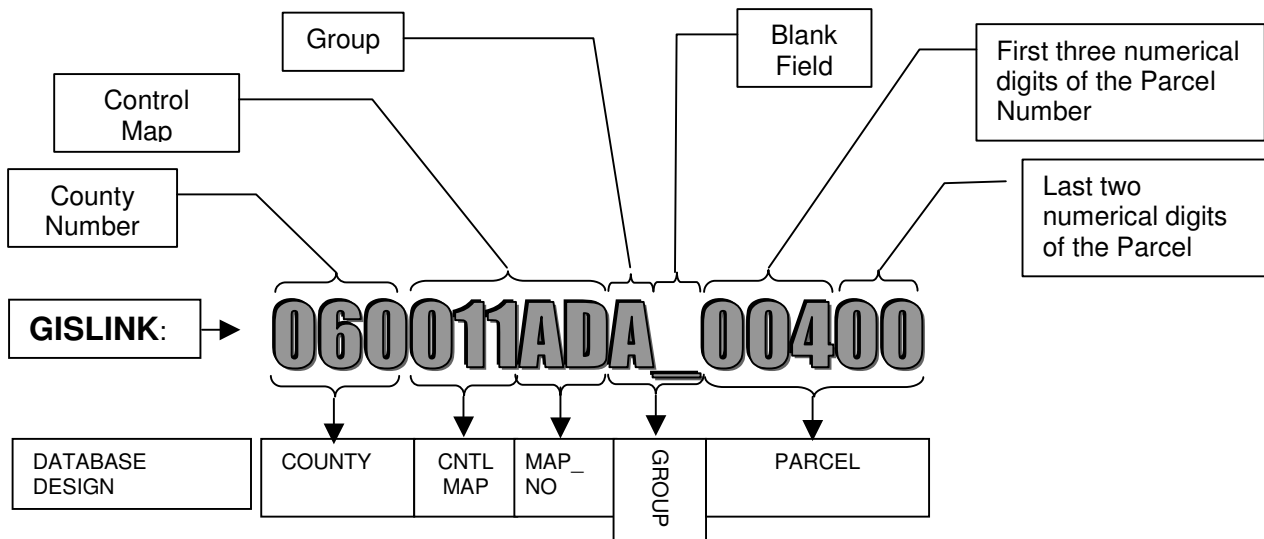
060 County number
 133 Control map number
 A 100' Control map insert letter
 A 50' Control map insert letter
 A Group letter
 Blank space
 030 Parcel number
 00 Split number (If the parcel does not have a split number, two zeros should be placed instead)



50' Example--parcel 4 in group A, on map 11AD translates to the GISLINK value:

060011ADA 00400

060 County number
 011 Control map number
 A 100' Control map insert letter
 D 50' Control map insert letter
 A Group letter
 Blank space
 004 Parcel number
 00 Split number (If the parcel does not have a split number, two zeros should be placed instead)



GROUP CORNER LINES (FIGURE 6)

Group corner lines are short, uniform, solid heavy lines that distinguish the boundary of each subdivided grouped area. They are usually coincident with parcel lines and only appear on 100' and 50' maps.

GROUP TEXT (FIGURE 6)

Group text identifies subdivided grouped areas and is part of the GISLINK field. Group text is shown as a large uppercase letter with quotations and is usually found in the center of the grouped area. Group text is placed parallel to the top and bottom map neat lines and only appears on 100' and 50' scale maps. Placement of group text should not overstrike other lines and text.

GROUP CORNER TEXT (FIGURE 6)

Group corner text is an integral part of the group corner line and the group text. Group corner text is displayed on the parcel map as the smaller uppercase letter with quotations and is usually found in the corners of the grouped area. Group corner text helps define the boundaries of each subdivided grouped area. As in group text and group corner lines, the group corner text is found only on 100' and 50' scale maps.

LAKE-POND NAMES (FIGURE 5)

Lake-pond names are to be placed in *italics* parallel with the top and bottom map neat lines.

LANDHOOK (FIGURE 5)

Landhooks are placed to show continuation of parcel ownership that is split by features such as roads or rivers and should be placed as shown on the source parcel map.

LEADER LINE

The purpose of a leader line is to associate text with a specific geographic feature. Leader lines are used when text placement occurs outside the boundaries of small features (e.g. parcel). Leader lines can be used with all annotation and are placed in the same annotation subclass as the text they reference. Leader lines are captured as an ArcInfo arrow with no angles or changes in direction, or arrowhead. This ArcInfo leader is part of the annotation feature class so that it is stored with the text in the appropriate annotation subclass.

LOT ACREAGE TEXT (FIGURE 6)

Lot acreage text is placed in the center of the parcel and directly under the lot number or letter. Text is also placed parallel to the top and bottom of map neatline and appears only on 100' and 50' maps.

LOT LINES (FIGURE 6)

Lot lines identify interior lots in parcels in subdivided areas and appear only on 100' and 50' maps (see Tract lines for 400' maps). Lot lines are symbolized as tic marks on the parcel map. However, lot lines will be captured as a solid line and symbolized in the digital file as a dashed line.

LOT NUMBER – LETTER TEXT (FIGURE 6)

Lot number – letter text is placed in the center of the lot and is parallel to the top and bottom map neatline and appears only on 100' and 50' maps. (See Tract Text for 400' maps)

MISCELLANEOUS TEXT (FIGURE 5)

Miscellaneous text is used anytime odd text appears on the parcel map itself, for example, "ASSESSED IN MAURY COUNTY", "PT. 39", "MINERAL BOUNDARY", "AIRPORT", and "LEVEE".

NEAT LINE (FIGURE 5)

The neat line is a line separating the body of a map from the map margin.

PARCEL CONFLICT LINE (FIGURE 5)

Parcel conflict lines are disputed boundary lines that show deeded areas that are in conflict. Landhooks are placed across conflict lines to aid in the clarification of ownership. Conflict lines are displayed as a series of uniform dash lines.

Note: *Conflict areas are not mapped consistently statewide and may present interpretation problems. In these instances, an Errata Note should be placed and the State will clarify.*

PARCEL CONFLICT TEXT (FIGURE 5)

Parcel conflict text identifies the area in conflict. Text is placed inside of conflict areas parallel with conflict line.

PARCEL DIMENSIONS (FIGURE 6)

Parcel dimensions display the size (frontage and depth) of a parcel. Dimensions appear on all scale maps, and are placed above or below, and parallel to the parcel boundary line. Dimensions are more frequently found in subdivided and congested areas consisting of smaller parcels. Dimensions may be placed under the leadered parcel number if they cannot fit inside of the parcel. Dimensions placed under leadered parcel numbers have the form '123 X 456'.

PARCEL LINES (FIGURE 5)

Parcel lines are solid and are used to denote parcel polygon boundaries.

PARCEL NUMBER (FIGURE 5 AND FIGURE 7)

A parcel number is the actual parcel identifier. Parcel numbers should be underlined and placed parallel to the top and bottom map neat line. The underline is included in the text font. For a 400' scale map, the parcel number is placed in the center of the parcel. On 100' and 50' scales map sheets, the number is placed in the upper right hand corner of the parcels.

PROPOSED RIGHT-OF-WAY (ROW) (FIGURE 5)

Proposed right-of-ways are road boundaries that are mapped on the source document by the state's mapping staff and are delineated by a solid red line.

PROPOSED RIGHT-OF-WAY TEXT

Proposed ROW text is not shown on the source parcel map. After capturing the proposed ROW the text "Proposed right-of-way" should be added to the digital data. Text should be placed inside and parallel to ROW lines. Text can be placed outside of ROW if annotation space is limited.

RIGHT-OF-WAYS (ROWS) (FIGURE 5)

There are two types of right-of-ways (ROW): road and railroad. When a railroad ROW intersects a road ROW, the railroad ROW is terminated and closed by the road ROW. Road ROWs do not have parcel numbers but are assigned a region in the parcel coverage. Railroad ROWs, on the other hand, do have valid parcel numbers (usually in the 400 series, i.e., 401, 402, etc.) and are defined as a region with a code value of 677, not the parcel value of 604.

RIGHT-OF-WAY TEXT (FIGURE 5)

All road and railroad ROW text is placed inside the ROW parallel to the feature on 50' and 100' scale maps and outside the ROW parallel to the feature for 400' scale maps using the abbreviations (Hwy. St.

and R.R.). Sound cartographic judgment should be used to determine placement of feature names if circumstances prevent the use of these guidelines.

RIVER-STREAM NAMES (FIGURE 5)

River-stream names are to be placed in *italics* at an angle with rivers or streams featured.

ROAD SYMBOLS (FIGURE 5)

Road symbols are used for 400', 100' and 50' scale maps. The four types of road symbols utilized will designate interstate, U.S., state and county highways. Road symbols will be placed inside the ROW on 100' and 50' map sheets and outside the ROW for 400' maps. Road symbols will consist of the symbol itself and the appropriate number as shown on the source parcel map. All symbols and numbers are placed parallel with the top and bottom map neat line.

SEE MAP NOTE (FIGURE 5)

These map notes are used to reference portions of a map, on all scales, that are parceled at a smaller or larger scale. (i.e. on a 400' map, SEE 1" = 100') Parcel lines and numbers are not shown in the reference area.

SPECIAL INTERESTS (CONDOMINIUM TEXT) (FIGURE 7)

Special Interest (Condominium Text) is a one, two or three-digit number placed in the center of a condominium footprint. The special interest numbers are *not* parcel numbers, i.e. 001, 002. Some condominiums may have individual parcel numbers and no special interest numbers. Special interest numbers should be placed parallel to the top and bottom map neatline. The parcel map is the source document for determining whether they are special interest or parcel numbers.

SPECIAL SCHOOL DISTRICT LINE (FIGURE 8)

Special school districts (SSD) are non-standard features and appear in limited counties. The special school district line will not form a parcel boundary. In most cases the SSD line is coincident with parcel boundaries and when this occurs both lines are captured. If the SSD line coincides with road or railroad ROW lines both lines will be captured. If the SSD line coincides with county and state lines only the administrative boundaries will be captured.

SPECIAL SCHOOL DISTRICT TEXT (FIGURE 8)

The special school district text is placed inside of the SSD line and should not overstrike other lines and text. Text is always placed parallel with the line and is displayed least once per map. The parcel map is the primary source for this information.

STATE LINE (FIGURE 9)

The state line forms a parcel boundary. Only the state line is captured if a parcel line coincides with the state line, county line, and a road or a railroad that runs concurrently with the state line.

STATE NAME (FIGURE 9)

The state name (Tennessee) is to appear on the inside of the state boundary. It is placed parallel with the state line at least once per map without overstriking any other text. Adjoining state names appear on the outside of the state line.

SUBDIVISION BLOCK NUMBER-LETTER (FIGURE 6)

Subdivision block number/letters appear only on 100' and 50' maps and are placed as shown on the source parcel map. They are placed parallel to the top and the bottom of the map neatline and in the center of the subdivision block with a circle around the block number letter. These features should be placed so they do not overstrike parcel lines or other text.

SUBDIVISION NAME – SECTION NUMBER (FIGURE 6)

Subdivision names and section numbers are used as a reference to locate and identify parcels within a subdivided area. The subdivision name and section number is usually found in the center of the subdivision block on 100' and 50'scale maps. Text should be placed parallel with map Neat lines and should not overstrike parcel lines or other text.

SUBDIVISION PLAT BOOK AND PAGE NUMBER (FIGURE 6)

Subdivision plat book and page number is a reference for locating subdivision plats filed as a public record. The plat book and page number is placed under the subdivision name-section number and parallel to the map neat lines. The 100' and 50' parcel maps are the primary source for this information.

TRACT ACREAGE TEXT (FIGURE 5)

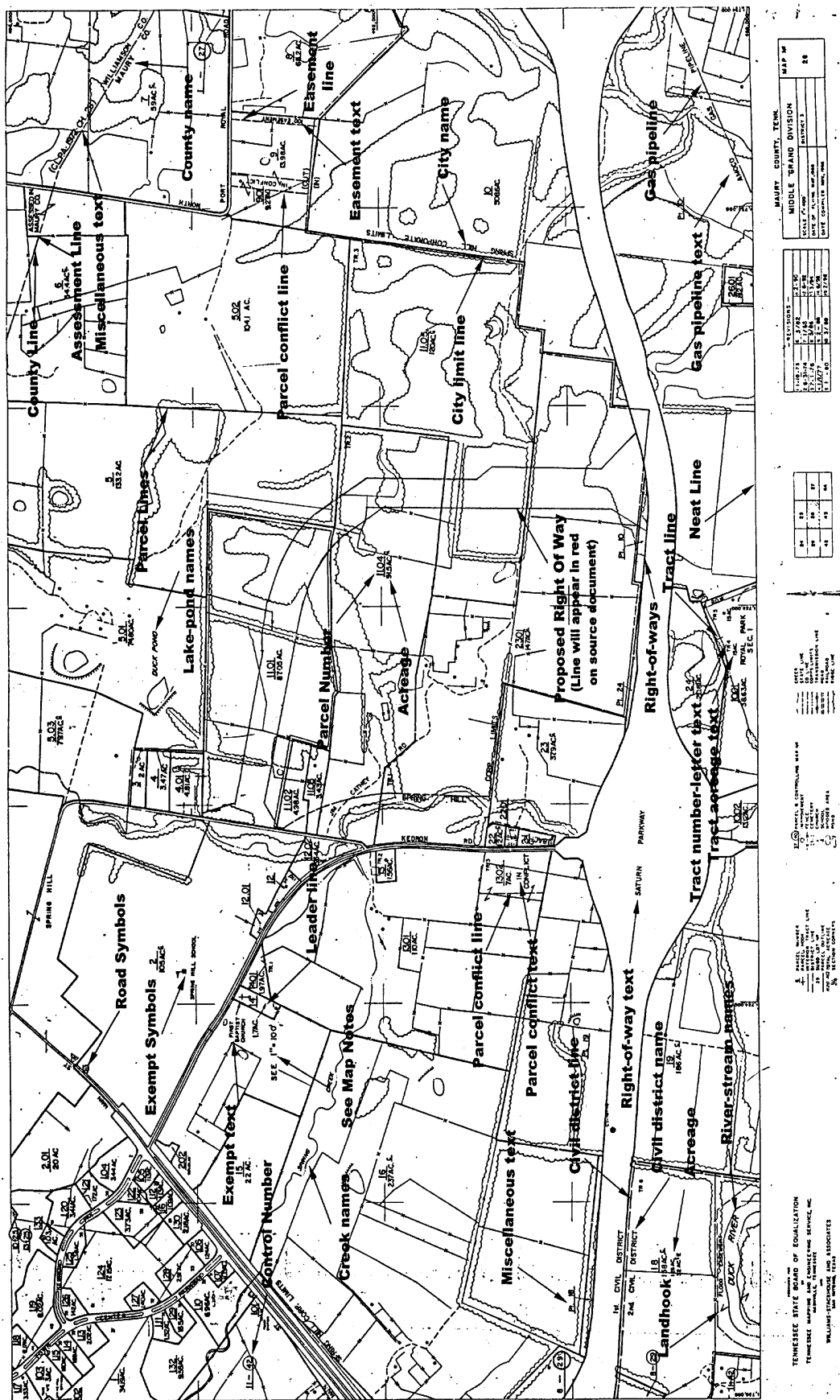
Tract acreage text appears only on 400' scale maps and is placed in the center of the tract and parallel with top and bottom map neatline. Tract acreage text is not found on all tracts of land.

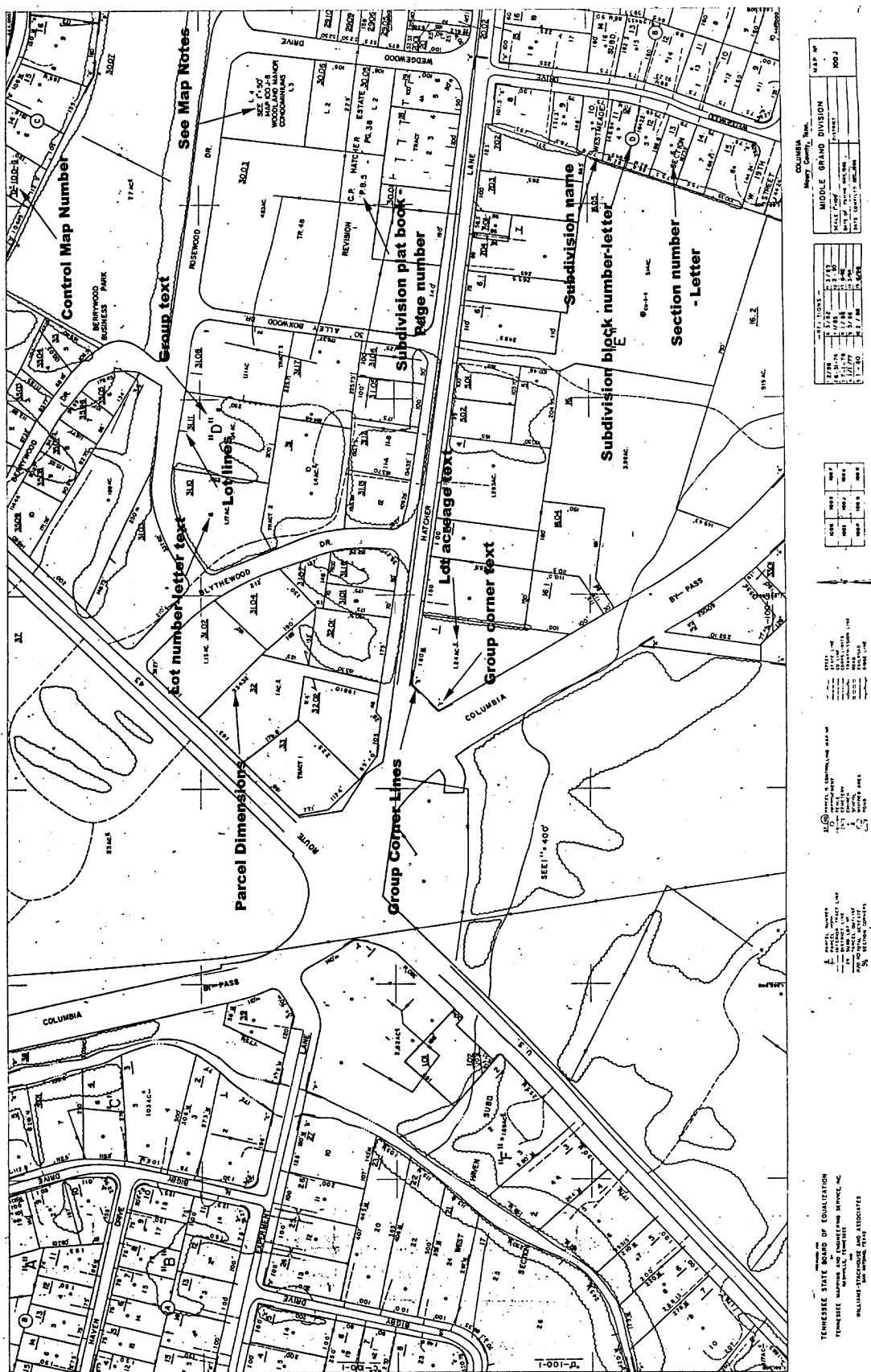
TRACT NUMBER-LETTER TEXT (FIGURE 5)

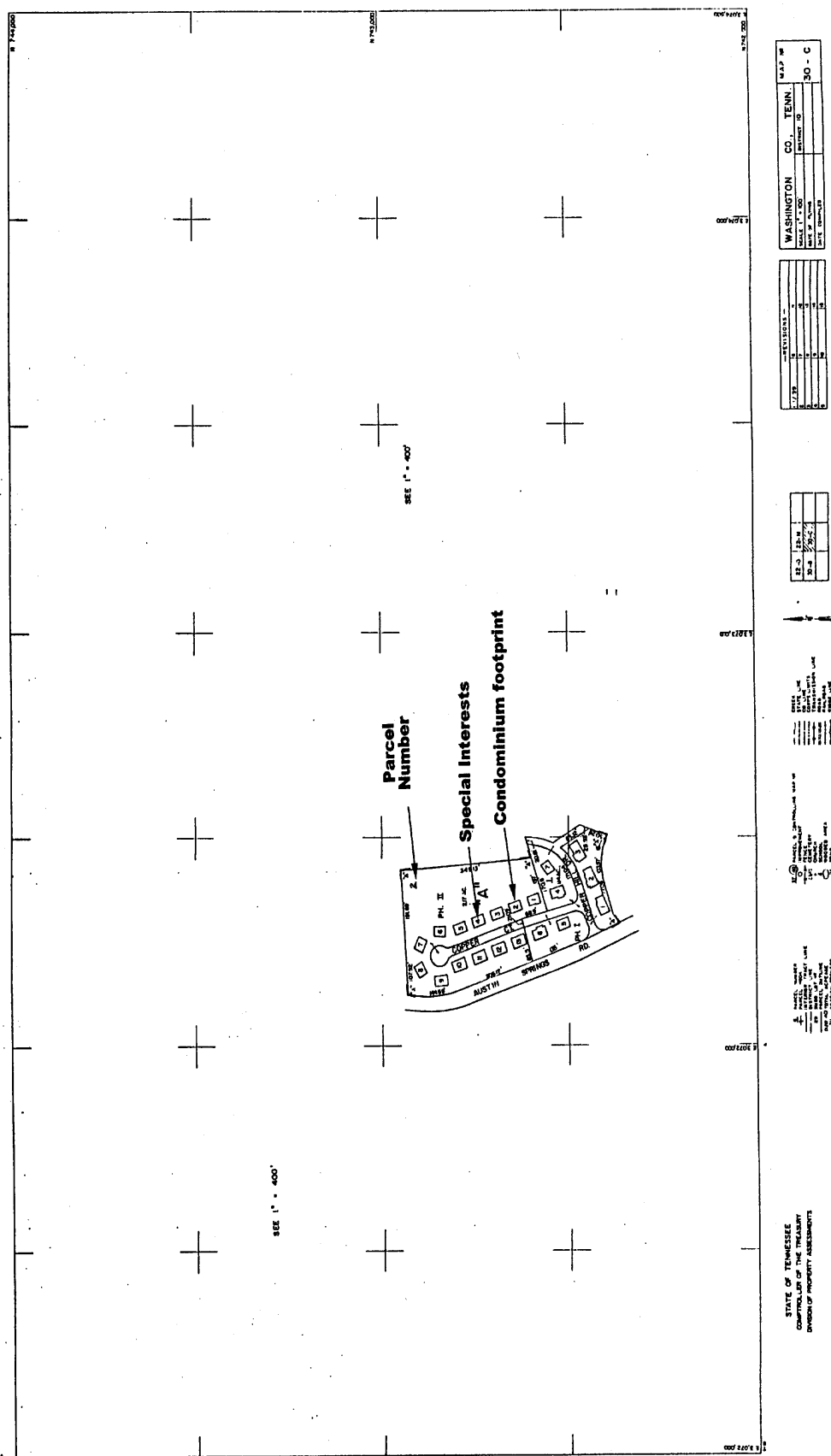
Tract number-letter text appears only on 400' scale maps. Tract number-letter is placed in the upper right-hand corner of the tract and parallel to the top and bottom map neat line.

TRACT LINE (FIGURE 5)

Tract lines are used to denote interior tracts on 400' scale maps. These lines are referred to as lot lines on 100' and 50' maps. Tract lines are displayed as tic marks on the parcel map. Tract lines will be digitized as a solid line and symbolized in the digital file as a dashed line.







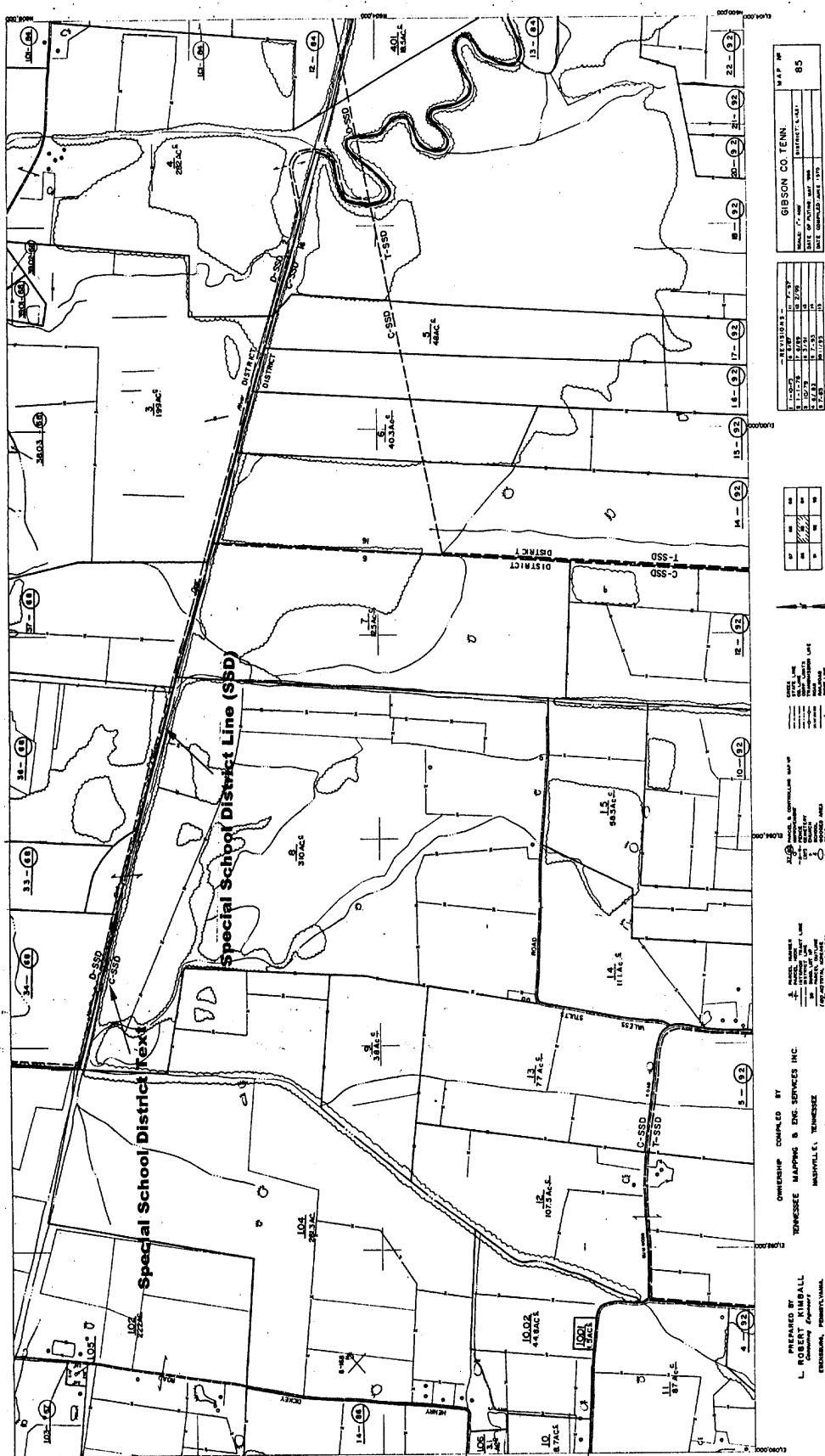


Figure 8: Cadastral Feature Definition(s)

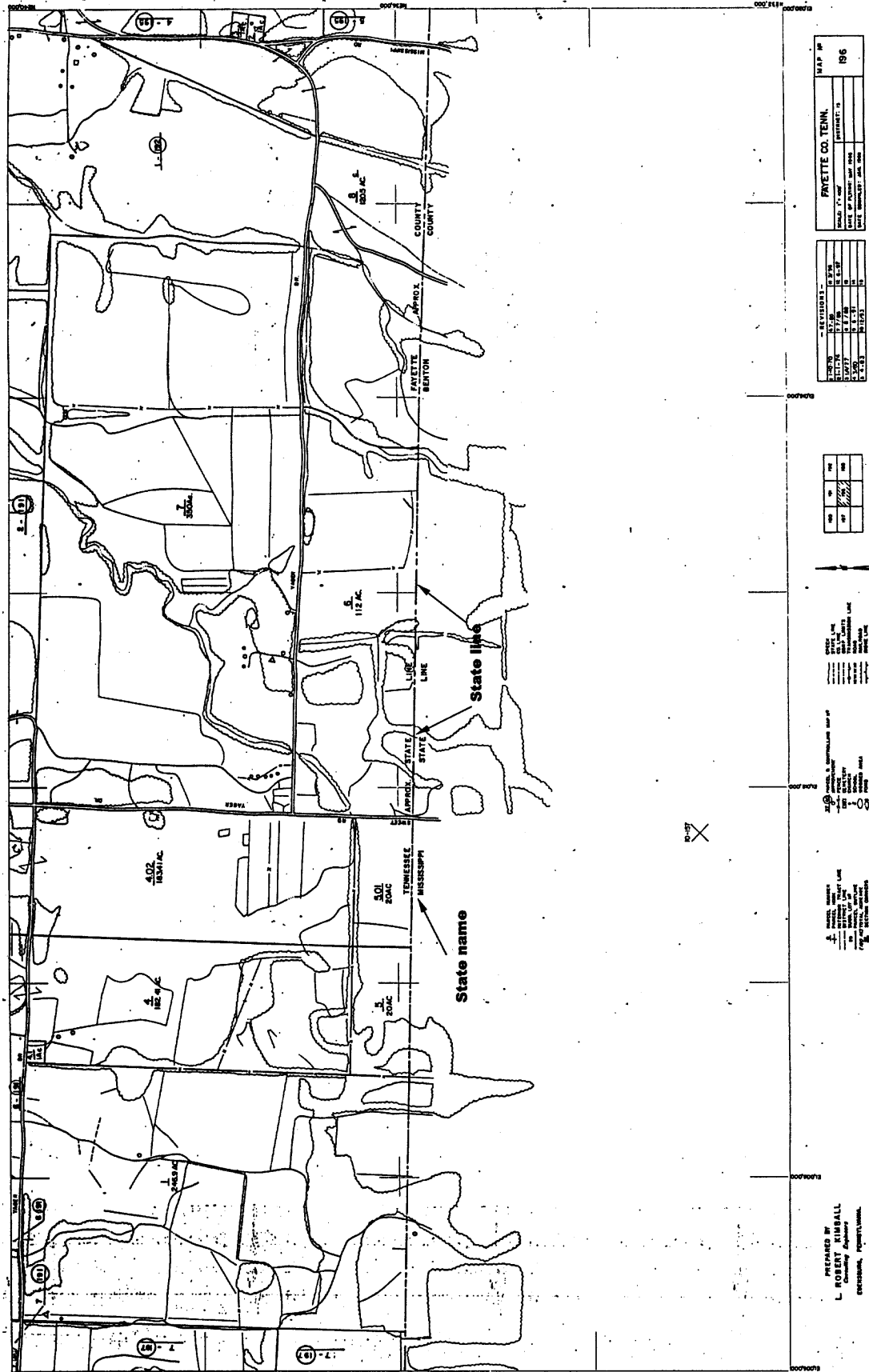
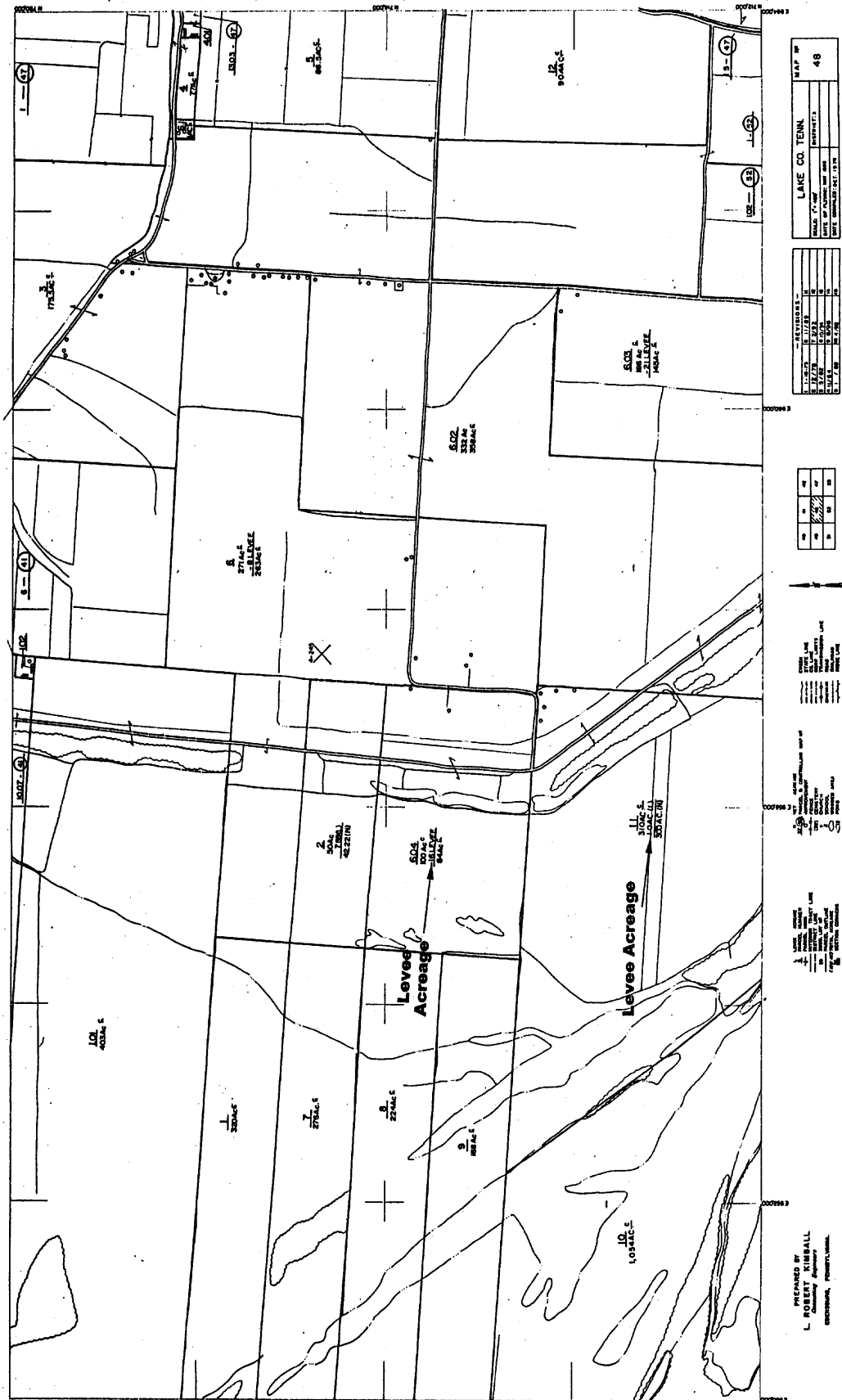


Figure 9: Cadastral Feature Definition(s)



6 Database Design Specifications

Introduction

This section contains the Arc/Info database design for the State of Tennessee parcel level Geographic Information System. The database design presented here is applicable to all county parcel data sets included in the State parcel level GIS. Several counties in the State have developed parcel databases prior to the implementation of these specifications. It is anticipated that most of these will retain their specification. Their parcel databases will be converted to these specifications if they should be integrated into the State parcel level GIS.

All vector data will be delivered in files that cover one 1"=400' map sheet and have the following characteristics:

Coordinate precision:	Double
Map units:	feet
Coordinate system:	Tennessee State Plane NAD83(90)
FIPS Zone:	4100
Fuzzy tolerance:	0.01
Dangle tolerance:	0.0
Map plotting scales:	1" = 50', 1" = 100' and 1" = 400'
Tics:	Placed coincident with tile (map sheet) neatline corners.
Tile Size:	14000 x 8000 feet

The default for numeric values will be zero (0).

The default for character attributes will be "" or NULL.

Map Librarian

Arc/Info Map Librarian will be used to manage the database. The INDEX used for the tiling scheme will be created from the existing 400' map sheet index used in the manual mapping system. The standard dimension of an existing manual 400' map sheet is 14,000' by 8,000'. The index will have both polygon and arc topology, and contain the items necessary for Arc Info Library management, including items TILE_NAME and LOCATION, PARCEL, PARCELLK, and all other data layers specified during the creation of the Map Library. This index will be named INDEX and will reside in the DATABASE directory. The sole purpose of this index coverage is to partition Arc/Info Library data by tile. Each arc in the INDEX coverage will be given a code value of 0 (zero). Likewise, each polygon in the INDEX coverage will be given a code of 0 (zero). For some additional layers, these code 0 (zero) default values are also used to define tile boundary arcs, and polygons outside the county.

Empty coverages shall be created and delivered per the specifications in this section when there are no features found in a 400' scale mapsheet.

On the extreme fringe areas of a county, a 400' map sheet was not created in order to avoid the need for a full 400' map sheet that contained only a small portion of a county. These areas typically are contained as an inset on an adjoining 400' map sheet. In the conversion to a digital parcel mapping system, these omitted map sheets will be created as 400' map sheets in the spatial index used in Map Librarian. They will be created on an as-needed basis.

All data is delivered in a 400' map sheet file unit. The 100' and 50' county index is used for administrative and plotting purposes only.

Tile Naming

Data is to be tiled into areas corresponding to 400' scale map sheets. These sheets will have a five-character name. The first two characters represent the county number followed by the three-character map number. For example, map 112 for Maury County would be named 60112.

In Arc/Info, these blocks of data correspond to workspace directories. Each coverage outlined in the database design (e.g. parcel, plan, etc.) will reside in these workspaces.

Annotation

Annotation shall be captured for all coverages and placed in an annotation subclass. Each annotation subclass contains specific names, levels, symbols, and sizes. Empty annotation subclasses shall be created and delivered per the specifications in this section when there are no annotation features found in a 400' scale mapsheet.

All annotation text must be placed as indicated in the Cadastral Feature Definitions (Refer to Section 5).

The following are guidelines for the placement of annotation:

To obscure the minimum amount of other features

Along (and splined to follow) linear features

Beside/above/under point features reading from west to east as appropriate

To occur at least once on each map sheet for which the map feature appears

To be correct as regards to grammar and spelling and to be in uppercase only

Text heights used in the coverages will conform to the specifications presented in the Database Layers Section. These have been developed from the Tennessee State Specifications for Property Ownership Mapping.

In certain circumstances text size may be modified as follows:

1. If the text will not fit in the appropriate position without overlapping other features, reduce the size to 75% of the specified size.
2. If the text will still not fit in the appropriate position without overlapping other features, reduce the size to 50% of the specified size.
3. If the text will still not fit in the appropriate position without overlapping other features, place the text in an open area as close as possible at the original specified size and use a leader line to associate the text to the mapped feature.

Note: Leader lines will be captured as a separate feature, an ArcInfo arrow, in the appropriate annotation subclass for the text it refers to.

Cadastral Edge-matching

All Arc/Info coverages must be completely edge-matched by coordinates and by attributes. All database features must be both visual and coordinate edge-matched with adjacent sheets. No edge-matching tolerance will be allowed. Attributes for adjoining features will be identical. Any edge-matching errors found on the source documents will be brought to the attention of the State for correction. Incremental delivery units will edge-match with previously delivered units.

Inclusion of Planimetric Features

Ridgelines and hydrographic features can form property boundaries and are shown on the parcel maps with a distinctive symbology. When this occurs, the feature defining the property boundary will be copied from the digital planimetric data and changed to a property line for the parcel coverage. These property lines will be coincident with the corresponding water and ridgeline features. In some instances, such as hydrography captured during extremely high or low water levels, line work will be captured from the parcel map sources.

Metadata

Consistent metadata is a critical component for documenting, evaluating, and distributing spatial data of all forms. Metadata conveys information users need to evaluate the fitness for applying a dataset for their needs. In its machine-readable format, it is searched and queried within an intranet or network-based Clearinghouse. Metadata further serves an important role in documenting the lineage and processing history of a dataset as it flows through the data life cycle.

Requirements

The State will compile FGDC-compliant metadata for each discrete unit (orthoimage, digital terrain model, planimetric and parcel coverage) on delivery of final digital data products. Detailed supporting data to facilitate this process will be provided by the vendor to the State with the final digital data delivery.

Supporting data for each discrete unit will include the file name, the size of the digital file in bytes, the coordinates of the southeast corner of the dataset in decimal degrees, and the date of the final digital data delivery. For orthoimagery products, additional supporting data for each discrete unit will include the photo acquisition date, the roll number, and the frame number.

Database Layers

Administrative Boundaries

Coverage Name: ***ADMIN***
Feature Class(es): Lines and Polygons
Description: Administrative Boundaries

		Item Name	Definition	Value(s)	Description
Polygons:	PAT	CODE	2,4,B,0	108	City
				112	County
		NAME	40,40,C	-	City or County name
Line:	AAT	CODE	2,4,B,0	101	State line
				105	City limit line
				109	County line

	Subclass	Level	Symbol	Size	Description
Annotation:	Stat	5	102	8.5	State Name (50)
	Stat	1	102	17.5	State Name (100)
	Stat	4	103	70	State Name (400)
	City	5	106	7	City Name (50)
	City	1	106	14	City Name (100)
	City	4	107	48	City Name (400)
	Cnty	5	110	8.5	County Name (50)
	Cnty	1	110	17.5	County Name (100)
	Cnty	4	111	70	County Name (400)

Notes:

1. When city and county lines are coincident, only the county line is captured. One arc, coded as county, will represent both city and county lines.
2. All polygon features that intersect with the tile boundary are closed using the tile boundary. The arc segment representing the tile boundary will have a code value of 0.
3. The text found adjacent to or near the city name labeled "(In) (Out)" indicate if the parcels are inside or outside the city limits. This text should be captured and placed in the City annotation subclass.

Civil District Boundaries

Coverage Name: ***CIVDIST***
Feature Class(es): Lines
Description: Civil District Boundaries

		Item Name	Definition	Value(s)	Description
Line:	AAT	CODE	2,4,B,0	145	Civil District line

		Subclass	Level	Symbol	Size	Description
Annotation:	Civil		5	146	7	Civil District name (50)
	Civil		1	146	14	Civil District name (100)
	Civil		4	147	56	Civil District name (400)

Notes:

1. The **CIVDIST** layer is captured for historical reference only. All annotation and arc features included are as they appear on the source document at the time of conversion to this specification.
2. The State will create a file containing a list of all 400' map sheets and their corresponding district numbers. This file is used to populate the district section in the legend during map production.

Special District Boundaries

Coverage Name: ***SPECDIST***
Feature Class(es): Lines and Polys
Description: Special District Boundaries

		Item Name	Definition	Value(s)	Description
Polygons:	PAT	CODE	2,4,B,0	155	School District
		NAME	40,40,C	-	School District name
Line:	AAT	CODE	2,4,B,0	155	School District line

	Subclass	Level	Symbol	Size	Description
Annotation:	Spec	5	148	7	School District name (50)
	Spec	1	148	14	School District name (100)
	Spec	4	149	56	School District name (400)

Notes:

1. The feature Special School Districts is used in only 7 counties: Carroll, Gibson, Henry, Obion, Scott, Williamson, and Wilson.
2. All polygon features that intersect with the tile boundary are closed using the tile boundary. The arc segment representing the tile boundary will have a code value of **0**.

Hydrographic Features - Creeks

Coverage Name: ***HYDROL***
Feature Class(es): Lines
Description: Hydrographic Features

		Item Name	Definition	Value(s)	Description
Line:	AAT	CODE	2,4,B,0	724	Creek
				727	Hidden Creek

	Subclass	Level	Symbol	Size	Description
Annotation:	Crek	5	725	6	Creek Name (50)
	Crek	1	725	12	Creek Name (100)
	Crek	4	726	48	Creek Name (400)

Hydrographic Features – Lakes/Rivers

Coverage Name: ***HYDROP***
Feature Class(es): Polygons
Description: Hydrographic Features

		Item Name	Definition	Value(s)	Description
Polygons:	PAT	CODE	2,4,B,0	717	Lake/Pond
				722	River/Stream
				764	Island
Line:	AAT	CODE	2,4,B,0	714	Lake/Pond
				718	Hidden Lake/Pond
				719	River/Stream
				723	Hidden River/Stream
				763	Borderline at confluence

	Subclass	Level	Symbol	Size	Description
Annotation:	Lake	5	715	8.75	Lake/Pond (50)
	Lake	1	715	17.5	Lake/Pond (100)
	Lake	4	716	70	Lake/Pond (400)
	Rivr	5	720	8.75	River (50)
	Rivr	1	720	17.5	River (100)
	Rivr	4	721	70	River (400)

Notes:

1. All polygon hydro features that intersect with the tile boundary are closed using the tile boundary. The arc segment representing the tile boundary will have a code value of **0**.
2. Borderline at confluence (**PAT** code **763**) is placed logically to delineate different bodies of water as indicated by a change of name on the source document.

Parcel and Right of Ways

Coverage Name: **PARCEL**
Feature Class(es): Lines and Regions
Description: Parcels and Right-of-ways

		Item Name	Definition Value(s)	Description
Region:	PATPARC	CODE	2,4,B,0	604 Parcel
				605 Common Area
				673 Street R.O.W.
				677 Railroad R.O.W.
				678 Parcel in conflict
				679 Condominium
				717 Lake/Pond
				722 River
				998 Unknown
		GISLINK	15,15,C	- Parcel Number
		GISLINK2	15,15,C	- Secondary Parcel Number
		CALC_ACRE	4,10,F,2	- Calculated Acreage
		MAP	5,5,C	- Physical Map No. (see notes below)
		Redefined: COUNTY	3,3,C	- County Number (col. 27)
		Redefined: CNTLMAP	3,3,C	- Control Map Number (col. 30)
		Redefined: MAP_LTR	2,2,C	- Map Insert Letter (col. 33)
		Redefined: GROUP	2,2,C	- Group Number (col. 35)
		Redefined: PARCEL	5,5,C	- Parcel Number (col. 37)
Line:	AAT	CODE	2,4,B,0	601 Parcel line
				662 Street R.O.W. line
				674 Railroad R.O.W. line
				101 State line
				109 County line
				651 Parcel conflict line
				714 Lake/Pond
				719 River
		* ANGLE	10,10,C	-
		* DISTANCE	8,8,C	-
		* RADIUS	8,8,C	-
		* DELTA	10,10,C	-
		* TANGENT	8,8,C	-
		* ARCLENGTH	8,8,C	-
		* SIDE	1,1,C	-
		* CURVE_FLAG	1,1,C	-

- Notes:**
1. COGO attributes (denoted with an *) are populated in post conversion but prior to delivery and will be used only for on-going maintenance.
 2. **PAT** code **998 – Unknown** is used only where a GISLINK cannot be determined based upon the available source document.
 3. **GISLINK** field – Reference Cadastral Feature Definitions, **GISLINK** for additional information.
 4. Road ROWs do not have parcel numbers and are given a code value **673** in the **PATPARC**.

5. Railroad ROWs have valid parcel numbers (usually in the 400 series, ie: **401**, **402**, **403**, etc.) and are given a code value of **677**. These railroad ROW parcels are included in the **PATPARC** region subclass.
6. Polygons falling within a 400' index map sheet, but outside of the county and/or parcel, will not be defined as regions.
7. The **GISLINK2** field is reserved for counties that participate in the county wide or 50' scale repining process. It is populated with the old Parcel Number while the **GISLINK** field contains the Parcel Number resulting from repining. The **GISLINK2** field is left blank for those counties who do not need repining.
8. The **MAP** field is reserved for counties that require repining; either county wide or 50' scale repining. The physical map number that contains the **new** parcel annotation is populated in this field and is left blank for those counties who do not need repining.
9. All polygon parcel features that intersect with the tile boundary are closed using the tile boundary. The arc segment representing the tile boundary will have a code value of **0**.
10. Common areas may or may not have a parcel number assigned to it. When no parcel number is found, these areas should be coded as "common area" with no **GISLINK** value. If a parcel number does exist, these areas should be coded as "parcel" and assigned an appropriate **GISLINK** value.
11. ROW Text: Street/Highway Name names will be captured from the source document that correspond to a road right-of-way or a street centerline (symbolized with a single dashed line on the source document) and placed in the **Srow** anno subclass.

Coverage Name: **PARCEL** (Cont.)
Feature Class(es): Lines and Regions
 Parcels and Right-of-ways
Description:

	Subclass	Level	Symbol	Size	Description
Annotation:	Parc	5	602	10.5	Parcel Number (50)
	Parc	1	602	21	Parcel Number (100)
	Parc	4	603	105	Parcel Number (400)
	Srow	5	663	7	ROW Text: Street/Highway Name (50)
	Srow	1	663	14	ROW Text: Street/Highway Name (100)
	Srow	4	664	48	ROW Text: Street/Highway Name (400)
	Row	5	675	7	ROW Text: Railroad Name (50)
	Row	1	675	14	ROW Text: Railroad Name (100)
	Row	4	676	48	ROW Text: Railroad Name (400)
	Dime	5	627	5	Parcel Dimension (50)
	Dime	1	627	10	Parcel Dimension (100)
	Dime	4	628	22.5	Parcel Dimension (400)
	Acre	5	629	5	Acreage (50)
	Acre	1	629	10	Acreage (100)
	Acre	4	630	56	Acreage (400)

Other Parcel Features

Coverage Name: ***PARCELLK***
Feature Class(es): Lines and Points
Description: Other Parcel line and Point Features

		Item Name	Definition	Value(s)	Description
Points:	XAT	CODE	2,4,B,0	656	Exempt Symbol: Church (100)
				657	Exempt Symbol: Church (400)
				658	Exempt Symbol: Cemetery (100)
				659	Exempt Symbol: Cemetery (400)
				660	Exempt Symbol: School (100)
				661	Exempt Symbol: School (400)
				665	Road Symbol: Interstate Highway (100)
				666	Road Symbol: Interstate Highway (400)
				667	Road Symbol: US Highway (100)
				668	Road Symbol: US Highway (400)
				669	Road Symbol: State Highway (100)
				670	Road Symbol: State Highway (400)
				689	Sub. Block Circle (100)
				690	Road Symbol: County Highway (100)
				692	Road Symbol: County Highway (400)
				693	Sub. Block Circle (400)
				699	Exempt Symbol: Church (50)
				700	Exempt Symbol: Cemetery (50)
				701	Exempt Symbol: School (50)
				702	Road Symbol: Interstate Highway (50)
				703	Road Symbol: US Highway (50)
				704	Road Symbol: State Highway (50)
Line:	AAT	CODE	2,4,B,0	705	Sub. Block Circle (50)
				706	Road Symbol: County Highway (50)
				607	Easement line
				621	Lot line/Tract line
				622	Proposed R.O.W.
				625	Group Corner Line
				637	Land Hook (50/100)
				638	Land Hook (400)
				646	Parcel Control Circle (400)
				673	Condo Footprint
				681	Gas Pipe Line

Notes:

1. The Sub. Block Circle features are captured as points and symbolized as circles.
2. Land hook measurements for each half:
 - 400' Land Hook: line length = 145, hook angle = 45 deg., hook length = 40
 - 100' Land Hook: line length = 60, hook angle = 45 deg., hook length = 20
 - 50' Land Hook: line length = 40, hook angle = 45 deg., hook length = 10

Coverage Name: ***PARCELLK*** (Cont.)
Feature Class(es): Lines and Points
Description: Other Parcel line and Point Features

	Subclass	Level	Symbol	Size	Description
Annotation:	Inter	5	604	5	Special Interest Text – Condominium (50)
	Inter	1	604	10	Special Interest Text – Condominium (100)
	Inter	4	610	40	Special Interest text – Condominium (400)
	Esmt	5	608	5	Easement Text (50)
	Esmt	1	608	10	Easement Text (100)
	Esmt	4	609	40	Easement Text (400)
	Snam	5	614	7	Subdivision Name, Plat Book/Page (50)
	Snam	1	614	14	Subdivision Name, Plat Book/Page (100)
	Snam	4	615	48	Subdivision Name, Plat Book/Page(400)
	Blick	5	620	7	Subdivision Block Number (50)
	Blick	1	620	14	Subdivision Block Number (100)
	Blick	4	620	28	Subdivision Block Number (400)
	Lotrt	5	623	6	Lot Number/letter text (50)
	Lotrt	1	623	12	Lot Number/letter text (100)
	Lotrt	4	624	40	Tract line text (400)
	Grpc	5	626	5	Group Corner text (50)
	Grpc	1	626	10	Group Corner text (100)
	Grpc	5	626	14.5	Group text (50)
	Grpc	1	626	29	Group text (100)
	Misc	5	635	5	Miscellaneous text (50)
	Misc	1	635	10	Miscellaneous text (100)
	Misc	4	636	40	Miscellaneous text (400)
	Erra	9	643	10/20/40	Erratta text
	Exem	5	683	5	Exempt text (50)
	Exem	1	683	10	Exempt text (100)
	Exem	4	684	40	Exempt text (400)
	Cntl	5	647	10.5	Parcel/Control Number (50)
	Cntl	1	647	21	Parcel/Control Number (100)
	Cntl	4	648	84	Parcel/Control Number (400)
	Lacre	5	649	5	Lot Acreage text (50)
	Lacre	1	649	10	Lot Acreage text (100)
	Lacre	4	650	28	Tract Acreage text (400)
	Conf	5	652	6	Parcel Conflict line text (50)
	Conf	1	652	12	Parcel Conflict line text (100)
	Conf	4	653	48	Parcel Conflict line text (400)
	Gasl	5	679	6	Gas Pipe line text (50)
	Gasl	1	679	12	Gas Pipe line text (100)
	Gasl	4	680	48	Gas Pipe line text (400)
	Note	5	681	7	"See Map" note (50)
	Note	1	681	14	"See Map" note (100)
	Note	4	682	48	"See Map" note (400)
	ProROW	5	685	7	Proposed ROW text (50)
	ProROW	1	685	14	Proposed ROW text (100)
	ProROW	4	686	48	Proposed ROW text (400)

Edge of Pavements

Coverage Name: ***EOP***
Feature Class(es): Lines and Polygons
Description: Edge of Pavements (100' scale only)

		Item Name	Definition	Value(s)	Description
Polygons:	PAT	CODE	2,4,B,0	707	Paved Road
				709	Background
Line:	AAT	CODE	2,4,B,0	707	Road Edge
				710	Hidden Road Edge

Notes:

1. Paved Road (**707**) polygon features that intersect with the tile boundary are closed using the tile boundary. The arc segment representing the tile boundary will have a code value of **0**.
2. Background (**709**) polygons are formed when an area is completely surrounded by arcs representing either Road Edges (**707**) or Hidden Road Edges (**710**). The neatline will never be used as an artificial closing arc for Background (**709**) polygons.

Ridgelines

Coverage Name: ***Ridge***
Feature Class(es): Lines
Description: Ridgelines required for parcel mapping

		Item Name	Definition	Value(s)	Description
Line:	AAT	CODE	2,4,B,0	757	Ridgelines

Notes:

1. Ridgelines (**757**) are extracted from the Digital Terrain Model (DTM) as needed and indicated on the original source document. They are copied coincident from the DTM file to both the **PARCEL** layer where they are to be coded as a parcel line (**604**) and to the **RIDGE** layer where they are coded as a ridgeline (**757**).

Street Centerlines

Coverage Name: ***STREETS***
Feature Class(es): Lines
Description: Street Centerlines

		Item Name	Definition	Value(s)	Description
Line:	AAT	CODE	2,4,B,0	901	Street Centerline
				903	Hidden Street Centerline
				904	Driveway Centerline
				905	Hidden Driveway Centerline

Tree-Covered Areas

Coverage Name: ***TREE***
Feature Class(es): Lines and Polygons
Description: Tree Covered Areas

		Item Name	Definition	Value(s)	Description
Line:	AAT	CODE	2,4,B,0	501	Vegetated area
Poly:	PAT	CODE	2,4,B,0	501	Vegetated area (400' scale only, >10 acres)
				510	Non-vegetated area

Notes:

1. All polygon features that intersect with the tile boundary are closed using the tile boundary. The arc segment representing the tile boundary will have a code value of 0.
2. Non-vegetated area (**510**) polygons are formed when an area is completely surrounded by arcs representing vegetated areas (**501**). The neatline will never be used as an artificial closing arc for Non-vegetated area (**510**) polygons.

Other Countywide Coverages

400' Scale Mapping Index

Coverage Name: **INDEX400**
Feature Class(es): Polygons
Description: 1"=400' Mapping Grid

		Item Name	Definition	Value(s)	Description
Poly:	PAT	TILE_NAME	5,5,C	-	Tile Name
		MAP_NUMBER	3,3,C		400' Map Number

		Subclass	Level	Symbol	Size	Description
Annotation:	Nam		1	1	2500	400' Map Number

Notes:

1. **INDEX400** polygons will cover the same spatial extent as the Librarian coverage **INDEX**, including fringe areas of the county where 400' map sheets previously did not exist.
2. **TILE_NAME** values will include the county number and 400' map sheet with leading zeros (maps 1-99) but will not include an underscore (i.e. 64023). (**TILE_NAME** attributes must reflect folder names contained in "Tiles" subdirectory in final delivery)
3. Annotation (subclass Nam) will not include the county number, or leading zeros but only the 400' map number (i.e. 23).
4. Attributes for **MAP_NUMBER** will not have leading zeros for maps 1-99.

100' Scale Mapping Index

Coverage Name: ***INDEX100***
Feature Class(es): Polygons
Description: 1"=100' Mapping Grid

		Item Name	Definition	Value(s)	Description
Poly:	PAT	TILE_NAME	6,6,C	-	Tile Name
		MAP_NUMBER	4,4,C		400' Map Number and 100' letter
		CODE	2,4,B,0	0	100' property map not active
				1	100' property map is active
		ORTHOCODE	2,4,B,0	0	No ortho present
				1	Ortho present

	Subclass	Level	Symbol	Size	Description
Annotation:	Nam	1	1	700	100' Map Letter

Notes:

1. **INDEX100** polygons will cover the entire extent of the county such that each **INDEX400** polygon will contain sixteen **INDEX100** polygons.
2. Only those **INDEX100** polygons with a code of 1 (in use) will receive annotation. An **INDEX100** polygon will be determined to be in use when a 100' parcel map sheet has been created for that polygon.
3. **TILE_NAME** values will include the county number, 400' map sheet and 100' map letter (i.e. 64023A) with no underscore.
4. Annotation (Subclass **Nam**) will not include the county number, underscore, or 400' map numbers, but only the 100' map letter (i.e. A)
5. **MAP_NUMBER** values will include the 400' map numbers and 100' map letter (i.e. 23A) and not contain leading zeros for maps 1-99.
6. **CODE** items will only appear in the PAT and should not be placed in the AAT.
7. **ORTHOCODE** is used to indicate which 100' index polygons have a corresponding orthophoto. In many cases this value will match the **CODE** value, but there may be instances where the State and/or county will request orthophoto production without having a corresponding 100' property map. Conversely, there may also be instances where a 100' property map exists but does not have a corresponding orthophoto. This difference usually occurs when the county property assessor creates new 100' maps prior to the start of parcel conversion but after tasking for aerial photography.

50' Scale Mapping Index

Coverage Name: ***INDEX50***
Feature Class(es): Polygon
Description: 1"=50' Mapping Grid

		Item Name	Definition	Value(s)	Description
Poly:	PAT	TILE_NAME	7,7,C	-	Tile Name
		MAP_NUMBER	5,5,C		400' Map Number with 100' and 50' letters

	Subclass	Level	Symbol	Size	Description
Annotation:	Nam	1	1	200	50' Map Letter

Notes:

1. **INDEX50** polygons will exist only where 50' maps have been created prior to conversion.
2. **TILE_NAME** values will include the county number, 400' map sheet, 100' map letter, and 50' map letter (i.e. 64023AB) with no underscore.
3. Annotation (Subclass Nam) will not include the county number, underscore, 400' map numbers, or 100' map letter, but only the 50' map letter (i.e. B)
4. For counties that are eliminating the existing 50' map sheets and incorporating them into the 100' map sheets, no **INDEX50** coverage is required.

Photography Index

Coverage Name: ***PHONDX***
Feature Class(es): Points
Description: Photo Center Index

		Item Name	Definition	Value(s)	Description
Point:	XAT	CODE	2,4,B,0	401	High Altitude
				402	Low Altitude
		EXP	12,12,C	-	Exposure Number
		ACQ	8,8,C	-	Date Acquired
		LINE_NO	3,3,C	-	Flight Line Identifier
		COUNTER_NO	4,6,B	-	Camera Counter Number
		ROLL_NO	10,10,C	-	Film Roll Number

Notes:

1. The Date Acquired format for the **ACQ** field will be YYYYMMDD.

Digital Terrain Model (DTM)

The file format for DTMs is MicroStation Version SE (DGN). This file format uses a series of attributes defining values for Level, Color, Line Style, and Weight to identify features contained in a file. Using specific values assigned to each of these four attributes, the features contained in each DTM can be uniquely identified. Features included in the DTMs are discussed in Section 6 above. The following table identifies all of the unique attribute values for all potential features contained in the DTM:

Unlike the Arc/Info layers described in the previous sections, Librarian is not used to manage the DTM files. A DTM file is provided for each digital ortho image at both 100' scale and 400' scale. However, each DTM used to create a 100' scale ortho image shall also be included in the parent 400' scale DTM.

FEATURE DESCRIPTION	LEVEL	COLOR	LINE STYLE	WEIGHT
FALSE MASS POINTS	4	6	0	4
MASS POINTS	5	2	0	4
WATER MASS POINTS	6	1	0	4
BREAKLINES	7	3	0	1
BREAKLINES *	7	10	0	1
BREAKLINES ON BRIDGE DECK (IN 400-SCALE AREAS) *	8	10	3	1
BREAKLINE (RR CENTERLINE)	11	6	1	2
BREAKLINE (RR CENTERLINE) *	11	6	0	1
BREAKLINE (RR CENTERLINE ON BRIDGE DECK)	10	6	3	1
ROAD CENTERLINE	15	0	3	1
ROAD CENTERLINE *	15	0	0	1
ROAD CENTERLINE ON BRIDGE DECK	18	0	3	1
DRIVE CENTERLINE (OVER 200')	19	3	2	1
DRIVE CENTERLINE (OVER 200') *	19	3	0	1
DRIVE CENTERLINE ON BRIDGE DECK	20	3	3	1
CREEK (UNDER 25')	29	7	6	1
CREEK (UNDER 25') *	29	7	0	1
RIVERS (OVER 25')	28	7	6	1
RIVERS (OVER 25') *	28	12	0	1
LAKE/ POND (OVER 25')	27	1	7	1
LAKE/POND (OVER 25') *	27	1	0	1
Additional Features in 100' DTM only:				
EOP IMPROVED ROAD ON BRIDGE DECK *	17	4	3	1
EOP IMPROVED ROAD	16	4	3	1
EOP IMPROVED ROAD *	16	4	0	1

Note: WORKING UNITS = 1000/1 SF/TH

GLOBAL ORIGIN = 0,0,0

NOTES:

1. False Mass Points are a derived point of elevation based on the average elevation surrounding a building feature that is of significant size. The area of a building is considered depending on Map Sheet scale. For 100' scale map sheets, any structures larger than 300' x 300' (90,000 square feet or approximately 2 acres) will require the addition of a False Mass Point. For 400' scale map sheets, any structures larger than 900' x 900' (810,000 square feet or approximately 18.5 acres) will require the addition of a False Mass Point.
2. The level, color, line style, and weight values for the features denoted above with an * have been altered to better improve internal quality review of the DTMs. Those marked with an * were implemented in Year 3 and all future production efforts.
3. The file naming convention for DTMs shall follow the system detailed for digital ortho images:
 - a. For 400' scale = 2 digit county code, 3 digit map sheet and the DGN extension
 - b. For 100' scale = 2 digit county code, 3 digit map sheet, 1 digit alpha inset, and the DGN extension.

7 SUMMARY OF PRODUCTS

The following list represents a summary of the products that the State is acquiring for each county from this project. Specific details of each item can be found in the appropriate section(s) of this document.

- USGS camera calibration report
- Flight Index
- GPS/IMU integration report (if required)
- Original film
- Analytical diapositives (if required)
- Scanned diapositives (if required)
- GCP layout, ASCII control file, and final control report
- Aerotriangulation report (if required)
- DTM data files
- Digital ortho imagery in GeoTIFF format
- Digital ortho imagery in compressed, multiresolution seamless image in MrSID format
- Hard copy ortho image plots
- Vector data sets as described in the database design
- Supporting digital data for metadata compilation

8 GLOSSARY OF TERMS

The following is a list of definitions that were compiled during the initial development of this specification document. The list has been sporadically maintained during that time and should not be considered the final authority for a specific item or entry. Periodically from time to time this list of definitions will be updated. It is included here to assist the reader who may be unfamiliar with terms used in this document.

Aerotriangulation - A process for the extension of horizontal and/or vertical control whereby the measurements on overlapping photographs are related into a spatial solution using the perspective principles of the photographs. This process results in the determination of the orientation elements of each photograph.

Airborne GPS - The use of GPS to determine the camera station positions within centimeters, thereby reduces the dependency on field surveying in photogrammetric mapping.

ASPRS – The American Society for Photogrammetry and Remote Sensing.

DTM - Digital Terrain Model. Elevations points and break lines collected for the purpose of modeling the terrain surface. This surface can be used to correct for elevation differences in creating an orthophotograph. Manual correlation involves an operator selecting points and measuring their elevations, whereas autocorrelation involves computer selection and measurement. Either may be used to collect a DTM. As used in this document the term DTM is synonymous with **DEM - Digital Elevation Model**.

Diapositive - A positive film transparency used in the photogrammetric process. This document uses the term analytical diap for a diapositive used for stereo compilation and aerotriangulation and scan diap for one used for scanning to create the digital orthophoto.

File, orthophoto - All digital orthophoto data needed to cover one map sheet. Area covered is a function of map scale.

File, planimetric and parcel - All data needed to cover the area of one 1"=400' scale map sheet.

Foot, U. S. Survey - There are two values for the foot, the U. S. Survey Foot and the International Foot. All work on this project will use the U. S. Survey Foot. Using this unit of measure, a meter equals 3.2808333333 feet (12 significant figures), and one foot equals .304800609601 meter. The exact relationship between feet and meters is important to the subject work for many reasons, one of which is that the geodetic datum used for airborne and field GPS surveying and Photogrammetry, NAD83, is expressed originally in meters. Conversion to feet is necessary for the Tennessee project and requires double precision computations. The Tennessee State Plane grid used on the maps for this project will display the distance units in U. S. Survey Feet.

GPS - Global Positioning System. Determination of coordinates of points using a network of satellites intended for this purpose.

Metadata - Data about data. A record containing information about a spatial data set or discrete unit of spatial data. The Federal Geographic Data Committee (FGDC) has published Geospatial Metadata Standards that will define the metadata to be collected.

National Map Accuracy Standards (NMAS) - A national standard of accuracy for published maps; published by the U. S. Bureau of the Budget in 1947. A new draft National Standard for Spatial Data Accuracy was published by the Federal Geographic Data Committee in 1996 and draft Geospatial Positioning Accuracy Standards were published by the FGDC in January 1997. A new accuracy standard was approved by FGDC in 1998.

Orthophoto - A scanned and registered aerial photograph that has been corrected for terrain elevation, camera tip and tilt, and other distortions to provide an image with the metric properties of a map. The correct positions of ground features can be measured from this image.

RMSE - Root Mean Square Error, a statistical measure of precision or accuracy of measurements.

Sheet - Map sheets on this project are at 1"=400', 1"=100' and 1"=50'. Each sheet has a neat area of 20 by 35 inches when plotted at the design scale. Map sheets are numbered the same as existing parcel maps and cover approximately the same area on the ground. Neatline position is in NAD 83 based on one point of reference for the state.

Tile – The basic organizational unit used for organizing and administering the data sets using Map Librarian. Each tile unit is represented by one 400' scale map sheet.

9 APPENDIX A

Tennessee Counties

County Name	Code	County Name	Code	County Name	Code	County Name	Code
Anderson	01	Fentress	25	Lauderdale	49	Roane	73
Bedford	02	Franklin	26	Lawrence	50	Robertson	74
Benton	03	Gibson	27	Lewis	51	Rutherford	75
Bledsoe	04	Giles	28	Lincoln	52	Scott	76
Blount	05	Grainger	29	Loudon	53	Sequatchie	77
Bradley	06	Greene	30	McMinn	54	Sevier	78
Campbell	07	Grundy	31	McNairy	55	Shelby	79
Cannon	08	Hamblen	32	Macon	56	Smith	80
Carroll	09	Hamilton	33	Madison	57	Stewart	81
Carter	10	Hancock	34	Marion	58	Sullivan	82
Cheatham	11	Hardeman	35	Marshall	59	Sumner	83
Chester	12	Hardin	36	Maury	60	Tipton	84
Claiborne	13	Hawkins	37	Meigs	61	Trousdale	85
Clay	14	Haywood	38	Monroe	62	Unicoi	86
Cocke	15	Henderson	39	Montgomery	63	Union	87
Coffee	16	Henry	40	Moore	64	Van Buren	88
Crockett	17	Hickman	41	Morgan	65	Warren	89
Cumberland	18	Houston	42	Obion	66	Washington	90
Davidson	19	Humphreys	43	Overton	67	Wayne	91
Decatur	20	Jackson	44	Perry	68	Weakley	92
Dekalb	21	Jefferson	45	Pickett	69	White	93
Dickson	22	Johnson	46	Polk	70	Williamson	94
Dyer	23	Knox	47	Putnam	71	Wilson	95
Fayette	24	Lake	48	Rhea	72		

10 APPENDIX B

Revision No. 1

Table below reflects the first revisions to the TNBMP Technical Specifications.

Revision No. 1 Change Table: April 30, 2001:		
Change No.	Description:	
1.	Add appropriate annotation specification to the multiple layers required for recreating 50' scale map sheets. The previous version included 50' scale annotation and 100' scale annotation being placed in the same level.	
	Table Impacted:	<i>(Multiple)</i>
2.	Define a CODE value for valid parcel regions that do not have an associated GISLINK value such as condominium "common areas".	
	Table Impacted:	PARCEL.PATPARC
3.	Eliminate polygon attribution for Street R.O.W.s in the PARCEL layer and add Street R.O.W.s to the PARCEL region subclass.	
	Tables Impacted:	PARCEL.PAT PARCEL.PATPARC
4.	Add GISLINK2 to the PARCEL layer subclass PATPARC for optional use during maintenance.	
	Table Impacted:	PARCEL.PATPARC
5.	Remove CODE 999 Outside from the PARCEL layer subclass PATPARC and clarify explanation of areas outside the county.	
	Table Impacted:	PARCEL.PATPARC
6.	Change the name of the redefined item MAP_NO to MAP_LTR in the Parcel layer subclass PATPARC to more closely reflect accepted practices.	
	Table Impacted:	PARCEL.PATPARC
7.	Define appropriate annotation specifications for INDEX50, INDEX100, and INDEX400 layers,	
	Tables Impacted:	INDEX50.PAT INDEX50.TATNAM (added) INDEX100.PAT INDEX100.TATNAM (added) INDEX400.PAT INDEX400.TATNAM (added)
8.	Add an item ACQ, LINE_NO, ROLL_NO, and COUNTER_NO to the PHONDY layer to contain the date each frame was acquired.	
	Table Impacted:	PHONDY.XAT
9.	Clarify and correct various text references. (Section 6 & 7)	
	Table Impacted:	<i>none</i>
10.	Add Feature Code for hidden driveway to STREETS layer.	
	Table Impacted:	STREETS.AAT
11.	Replace PLAN layer with EOP layer and RIDGE layer. Add appropriate definitions and notes.	
	Table Impacted:	PLAN.AAT EOP.AAT & EOP.PAT RIDGE.AAT

Revision No. 2

Table below reflects the second revisions to the TNBMP Technical Specifications.

Revision No. 2 Change Table: April 30, 2003:		
Change No.	Description:	
1.	Revision of Introduction to Executive Summary.	
	Table Impacted:	None
2.	Remove underscore from TILE_NAME values (i.e. 64023). Modify MAP_NUMBER item to contain 400' map number (i.e. 23) with no leading zeros for maps 1-99. Change description in Annotation layer subclass NAM from Tile Name (400) to 400' Map Number. CODE item will not appear in PAT or AAT.	
	Table Impacted:	INDEX400.PAT
3.	Remove underscore in TILE_NAME values (i.e. 64023A). Modify MAP_NUMBER to contain 400' map number and 100' map letter (i.e. 23A) with no leading zeros for maps 1-99. Changedescription of CODE item from in use/not in use to 100' property map is active or not Add item ORTHOCODE to reflect if Orthophoto is present or not. Change description in Annotation layer subclass NAM from Tile Name (100) to 100' map letter. CODE item will appear in the PAT but not in AAT.	
	Table Impacted:	INDEX100.PAT
4.	Remove underscore in TILE_NAME values (i.e. 64023AB). Modify MAP_NUMBER to contain 400' map number, 100' map letter and 50' map letter (i.e. 23AB) with no leading zeros for maps 1-99. Change description in Annotation layer subclass NAM from Tile Name (50) to 50' map letter. CODE item will not appear in PAT or AAT.	
	Tables Impacted:	INDEX50.PAT
5.	Add DTM Specification to Section 6	
	Table Impacted:	None
6.	Remove Ridgelines as a Value and a Description.	
	Table Impacted:	EOP.AAT
7.	Change PLAN layer to RIDGE layer in the notes.	
	Table Impacted:	RIDGE.AAT
8.	Separate corner text items and group text items into separate in Annotation layer subclass Grpc. Add Blck subclass to PARCELLK Annotation layer with appropriate definitions.	
	Table Impacted:	PARCELLK.TATGRPC (added)
9.	Clarify and correct various text references.	
	Table Impacted:	None
10.	Added final MrSID compression details to Ortho Specifications.	
	Table Impacted:	None

Revision No. 3

Table below reflects the third revision to the TNBMP Technical Specifications.

Revision No. 3 Change Table: April 30, 2004:		
Change No.	Description:	
1.	Revise County Index section.	
	Table Impacted:	None
2.	Add meaurements for each half of the Land Hooks to note section in PARCELLK coverage.	
	Table Impacted:	None
3.	Change feature Item CODE value = 708 to CODE = 707	
	Table Impacted:	EOP.pat
4.	Add Repining section.	
	Tables Impacted:	None
5.	Add 400-scale Subdivision Point Text Feature that creates a circle around the text, CODE = 693, SubBlock (400)	
	Table Impacted:	PARCELLK.xat
6.	Change description for Code 689 from Sub. Block Number/Letter (100) to Sub. Block Circle (100)	
	Table Impacted:	PARCELLK.xat
7.	Change description for Code 705 from Sub. Block Number/Letter (50) to Sub. Block Circle (50)	
	Table Impacted:	PARCELLK.xat
8.	Add description to note section in PARCELLK coverage that Sub. Block Circle are captured as points, then symbolized as circles.	
	Table Impacted:	None
9.	Revise DTM Specification section.	
	Table Impacted:	None
10.	Revise Photo Control, Methodology section to specify the size and dimensions of the prepaneled ground control points.	
	Table Impacted:	None
11.	Revise Leader Line definition in the Cadastral Feature Definitions.	
	Table Impacted:	None
12.	Revise Annotation section.	
	Table Impacted:	None

11 APPENDIX C – Ortho Update Pilot Program Specifications

With the conclusion of the initial statewide base map production, an examination of current technology and alternative methods for developing a sustainable approach for digital ortho maintenance is required.

A component of this work will be accomplished through the development of new digital ortho imagery for selected Tennessee counties during the spring 2007 and 2008 flying season.

The following section provides a detailed review of the revised technical specifications associated with the Tennessee Base Mapping Ortho Update Pilot Program.

Aerial Photography

The original specifications call for the creation of conventional panchromatic (black and white) film based photography as the source to create the digital ortho imagery (see Figure 11). With enhancements in digital cameras and a move in the photogrammetric industry towards developing color digital ortho imagery and LIDAR, the ortho pilot program will leverage these emerging technologies.

The ortho update pilot program will use the ADS40 digital camera as the sensor for data capture. The ADS40 source scale is not needed because it is not a frame camera. It gathers a complete “sweep” of pixels as the sensor collects data. The source scale for traditional film based photography relates to the negative scale of the film. The final scale for the ortho imagery developed for this project from the ADS40 digital camera is 1”=200’ with a native 1’ pixel resolution.

The basic geographic production unit is the county and associated 1”= 400’ map sheets, and will be identified on the Index Map for each county.

Acquisition Period: February 2007-April 2007

Geodetic Datum, Coordinate Systems, and Units of Measure:

National Geodetic Survey Second-order horizontal and Third-order vertical

North American Datum (NAD) 83(90 Epoch) for horizontal and North American Vertical Datum (NAVD) 88 for vertical

Tennessee State Plane (Fipszone 4100) coordinate system

Unit of measure, U.S. Survey Foot

GPS surveys will be tied to Tennessee High Accuracy Reference Network (HARN)

OrthoPhoto Horizontal Accuracy: +/- 2 pixels (+/- 2 feet RMSE)

Orthophoto Delivery Format: GeoTIFF (per 400’ map sheet) and MrSID (countywide only)

OrthoPhoto File Size: 336 MB (400’ scale mapsheet)

Digital Terrain Model

In addition to the digital image acquired through the ADS40 camera, a digital terrain model (DTM) is required to correct for scale variations and image displacement resulting from relief or terrain variations. The DTM created through the initial statewide production effort is suitable for ortho rectification associated with the ortho update pilot program. Using this existing DTM will save the State and local governments from spending additional dollars on creating an entirely new surface model or DTM.

The original DTM created through the Base Mapping Program consists of mass points and breaklines and is divided into two categories: standard and high accuracy. The standard DTM is suitable for ortho rectification and not intended for contour development (Although the standard DTM is capable of creating 20’ contours that meets National Map Accuracy Standards). The high accuracy DTM, when compared to the standard DTM, reflects a more

robust collection of mass points and breaklines. The high accuracy DTM is suitable for development of 2' contours for areas mapped at 1"=100' with a 6" pixel resolution and development of 10' contours for areas mapped at 1"=400' with a 2' pixel resolution.

DTM Update

In the event that there have been terrain changes in elevation, the ADS40 Digital Surface Model (DSM) will provide updated elevation surface data, in the form of mass points, for these areas. These ADS40 DSM mass points will be blended with the existing DTM (standard or high accuracy) mass points & breaklines to create a county-wide updated DTM.

Terrain change detection is applied using two separate methodologies:

First, once the new imagery is captured, a visual inspection of the existing imagery compared to the new imagery is employed. Areas that have experienced significant terrain change, such as new roads, intersections, large structures, mining operations, will be flagged for DTM update. All breaklines and mass points from the existing DTM in these flagged areas, will be removed from the DTM. Elevation mass points from the Leica ADS40 reflective digital surface model (DSM) will then be inserted into these flagged areas of terrain change. The mass points will be spaced at approx. 5 meter intervals over these areas. These mass points will then be blended with the breaklines and mass points from the existing DTM to create a seamless updated surface model over the entire county.

The next change detection method is applied by ortho-rectifying the new imagery using the updated surface model created from step one – above. Then image analyst perform visual inspections of the entire ortho-rectified county imagery to check for artifacts, such as: smears, “blackholes” and “spikes” in the imagery. These artifacts are an occurrence of the surface model elevations’ breaklines and mass points not lying on the ground. For example, an erroneous mass point or breakline elevation that has an elevation value that is below the surface of the ground will result in a “blackhole” (type of smear in the ortho); while a mass point or breakline elevation value that is above the surface of the ground will result in a “spike.” In the event that the image analyst detects any erroneous mass point or breakline elevation values, these areas will be flagged and will be substituted with the elevation mass points from the Leica ADS40 reflective digital surface model or will be corrected using manual 3D compilation. Once these edits are complete, the imagery will be Ortho-rectified using this updated DTM.

Updating the original standard DTM does not have a direct impact on the creation of contours since the standard DTM is intended for ortho rectification (The updated standard DTM remains suitable for creating a 20' contour).

Where a high accuracy DTM was created in selected communities, the updated DTM will remain suitable for creation of 2' and 10' contours, but in previous 2' contour areas that have changed the DTM will meet ASPRS class II accuracy standards. For areas that previously contained 10' contours, ASPRS Class I accuracy standards will be met.

The post spacing for the ADS40 DSM mass points would be approx. 2 meters.

DTM Delivery Format: .dgn Microstation File

LIDAR – Light Detection and Ranging

The ortho update pilot project will include the use of LIDAR, but only for Anderson County, Tennessee during the spring 2007 acquisition period. LIDAR is an alternative approach to developing a surface model for use in ortho rectification, and has applications that go beyond traditional ortho imagery development. LIDAR sensors transmit pulses of light that reflect off the terrain and other height objects. LIDAR systems collect positional (x,y) and elevation (z) data at pre-defined intervals. The resulting LIDAR data is a very dense network of elevation postings. The accuracy of LIDAR data is a function of flying height, laser beam diameter (system dependent), the quality of the GPS/IMU data, and post-processing procedures.

The following specifications identify how LIDAR will be used in the ortho update pilot project.

The contractor will compile supplemental breaklines from ADS40 orthos to acquire a bare earth surface model capable of 5' contours. Additional breaklines will result in contours that are smooth and aesthetically pleasing. Without additional breaklines the resulting contour features will appear rough and jagged.

Altitude of LIDAR Capture: 10,000' Above Mean Terrain (AMT)

Acquisition Period: February 2007-April 2007

Geodetic Datum, Coordinate Systems, and Units of Measure:

National Geodetic Survey Second-order horizontal and Third-order vertical

North American Datum (NAD) 83(90 Epoch) for horizontal and North American Vertical Datum (NAVD) 88 for vertical

Tennessee State Plane (Fipszone 4100) coordinate system

Unit of measure, U.S. Survey Foot

GPS surveys will be tied to Tennessee High Accuracy Reference Network (HARN)

LIDAR Point Spacing: 4.5 Meters (13.7 feet)

LIDAR Vertical Accuracy: 2.5'

LIDAR Data Delivery Format: ASCII .xyz files

LIDAR File Size (400' scale Mapsheet): Approx 15 MB. (The file size for each 400' scale mapsheet depends on the type of terrain, amount of trees and removal of obscured areas.)

Figure 11. Comparison of Ortho Imagery Specifications

Specifications Comparison Chart	Original TNBMP Ortho Specs	Revised TNBMP Ortho Pilot Specs
Photography	B/W Panchromatic Film	Digital Color
Scale	1" = 400' county wide 1" = 100' selected urban area	1" = 200' (Mosaicked to 400' index tile sheet)
Resolution	2' county wide 6" in selected urban area	1' county wide
Geographic Extent	Entire State	Selected TN Counties
DTM	Mass Points/Breaklines	Mass Points/Breaklines w/ supplemental data